TOPICS OF THE MONTH

Soviet science and us

SOME sober observations on the progress of science in the Soviet Union are made by Sir Miles Thomas, chairman of Monsanto Chemicals Ltd., who points out that the Western democracies are misinterpreting what is happening in the Soviet Union if they believe an increase in the scope and tempo of technical education is the answer to the growing power of Russia's technological advance as instanced by the first satellites.

Sir Miles points out that, though Russia is still a police state, its scientists form a community which is growingly liberal in thought and deed. 'No one with any scientific knowledge will believe that the mighty feat of launching the earth satellites was brought about by the use of whips and scorpions, or that they were the products of a science in which the law of tyranny has superseded the law of gravity,' he writes in the March issue of *Technology*, and continues: 'Few of us as yet are willing to accept the fact, but Soviet scientists are not "mass produced." They are not soul-less specialists, each knowing nothing but one small sub-division of a single branch of science. They are scientists by vocation rather than compulsion and before following their vocation they are, in common with all Russian children, given a thorough and genuine grounding in the humanities and liberal arts. The fact that it is accompanied by Marxist indoctrination is beside the point.'

All Russian school children learn about science as part of a wide general curriculum, Sir Miles goes on. At a much later stage, through an exhaustive programme of selection, the potential scientists are taught to specialise. The end-product is a scientist of quality, not an 'expert' who has been divorced from liberal education at the age of 14. An equally important fact is that he is a member of a society in which his non-scientific colleagues have nevertheless acquired a good basic understanding of science as part of their general education.

What is needed in Britain, according to Sir Miles, is not more specialisation at an earlier age, but less and later—much later. An intellectual climate is needed in which no man can claim to be educated who has no scientific knowledge and no scientist can graduate in ignorance of mankind's cultural achievements in non-scientific fields.

Are we, as Sir Miles suggests, in danger of creating the most fantastic paradox of all, in which a free society produces dehumanised scientists whose faculties have withered and died save in one narrowly specialised field, while a non-liberal police state creates scientists who are also cultured human beings, at the rate of 250,000 a year ?

New gasification processes for Britain

COMPLETE gasification of coal will open up for the Scottish gas industry a means of obtaining large quantities of gas from a type of coal hitherto regarded as unusable for this purpose. At the same time it will provide a basis for a new chemical and fuel industry. In a £6½-million plant to be built for the Scottish Gas Board at Westfield, Fife, the Lurgi pressure gasification process will be used with low-grade open-cast coal being fed into it by conveyor belt directly from a nearby mine. When completed, the plant will have a capacity of 30 million cu.ft./day of gas. An interim stage, valued at £4 million, will be built for an output of 15 million cu.ft./day. When in full operation, the Westfield plant will produce gas of low toxicity and much reduced sulphur content and at the same time the new process indicates possible lines of development for making new and valuable chemical by-products.

The coal will be completely gasified in the Lurgi generators at a pressure of about 25 atm. in a continuous stream of oxygen and superheated steam. Humphreys & Glasgow Ltd. (the main contractors for the complete new works), in association with the Power-Gas Corporation Ltd., have reached an agreement with the Lurgi Co. of Germany to build this section of the plant. Present plans indicate that the plant will be fabricated in the United Kingdom.

Heat in the crude gas from the generators will be used to produce steam in waste-heat boilers. Tar, oils and ammonia in the effluent will be recovered, the ammonia being concentrated in a plant to produce a 20% solution for sale. Benzole will also be recovered from the crude gas. The proportion of hydrogen in the gas is increased by a catalytic conversion plant. Carbon dioxide is next 'washed' out in a *Benfield* plant. The gas is then enriched by the hydrogenation of oil. This process has been developed by Dr. F. J. Dent, director of the Gas Council's West Midlands research station, where Humphreys & Glasgow have already built a 1-million-cu.ft./day hydrogenation pilot plant.

Finally it will pass through a further benzole recovery plant, recovering high-purity benzene, before passing through pressure oxide purifiers.

The Lurgi plant will be built over the next five years and will be the world's seventh plant to operate this process, others being in operation in Australia, Czechoslovakia, Germany and South Africa. Each of these installations has its own special characteristics. Thus, in the Australian plant, some third of the heat units in Lurgi gas are converted to liquid fuel, and two-thirds into the form of rich gas for town distribution. At the Sasolburg plant in South Africa the main objective

is the production of oil from coal by the latest methods of synthesis, while one reason for the development of the Lurgi process in pre-war Germany was that it afforded the possibilities of synthetic oil production from indigenous sources. The Dorsten, Western Germany, plant which was built in 1955 corresponds most nearly to the installation which will be built in Fife with the primary object of producing large quantities of gas.

Further evidence of the changing pattern of gas production in Britain can be seen in the £2-million project for Partington, near Manchester, for which the contract was recently signed by the North Western Gas Board acting for the Gas Council, and which is expected to hasten the full-scale development of a new process to produce gas by hydrogenation of oil or coal. The Partington plant is planned to be in operation at the beginning of 1960 and its gasification system will comprise the production and purification of hydrogen in excess of 90% purity by the gasification of oil (and at a later stage coal) at a pressure of 400 p.s.i. with oxygen and steam, and the use of this hydrogen for the production of rich gas by hydrogenating further oil or coal to produce gas of about 600 B.Th.U./cu.ft. calorific value. The rich gas is then diluted to the required calorific value by the addition of nitrogen.

The system has the advantage that both the specific gravity and the carbon monoxide content of the gas are under control. In this first installation it is intended that the carbon monoxide content of the gas should be at least as low as 1.5% or under, thus greatly reducing the toxicity of the gas. The organic sulphur content of the gas is also very low.

The *Texaco* process is to be used for the production of hydrogen for the Partington plant, while removal of carbon dioxide and hydrogen sulphide in the gases leaving the shift converters involves the *Benfield* process.

New paper process

THE development in Britain of a new economical process for making high-quality printing paper comes at an opportune time. In recent years the price of esparto grass, which is a wild grass growing in North Africa, particularly Tunisia and Algeria, has risen steeply. With the new process, maximum yields of pulp can be increased from 40 to 58% with no apparent deterioration of the quality of the paper.

There are a number of economies in other directions, *e.g.* in the quantity of caustic soda used. The process is extremely flexible and lends itself to automatic control. It is also suitable for use with straw.

High-quality printing papers of the type involved are normally made from a mixture of esparto grass pulp and wood pulp, the usual proportion being 60 to 40%. Such is the efficiency of the established process that the British Paper and Board Industry Research Association spent some 18 months trying to improve it without success. It was then that the idea of the new process was born.

In 1956, 266,000 tons of esparto grass, valued at £5.8 million, were imported, but political difficulties reduced the amount in 1957 to 188,000 tons. Under the established process this would have produced 75,000 tons of pulp; by use of the new process it will be possible to produce 110,000 tons of pulp.

Bigger welded vessels

NEW fabricating techniques, as well as the availability of metals in larger and more ductile sheets, are making possible the manufacture of larger and more complicated—or in some cases simpler—vessels and widening the scope of the chemical plant designer considerably. Two special welding jobs, quite unrelated except that they both happen to be for service with Imperial Chemical Industries Ltd., serve to illustrate this point.

One is a nitric absorption tower for I.C.I.'s Wilton works. In stainless steel, it weighs 93 tons, has an over all length of 139 ft. and a diameter of 15 ft. It was fabricated by Ashmore, Benson, Pease & Co. and the material used throughout was 18/18/1 austenitic steel. The shell was made in three distinct sections of differing plate thicknesses. Automatic welding was carried out using *Fusarc* machines for a series of sub-assemblies some 15 ft. long, in order to make the fullest use of the internal welding boom for automatically welding the internal seams. For external welding, a *Fusarc* welding head mounted on a universal type of cantilever was employed and beneath this the vessel was mounted on a heavy series roller bed, being rotated for the circumferential seams and traversed for the longitudinal seams.

In the fabrication of large-diameter vessels such as this column, a spider form of internal stiffening is usually fitted to maintain circularity of the vessel. In this case, however, other means had to be adopted so that the internal welding boom could be used. External stiffening rings were therefore used to maintain concentricity while the welding was in progress. These were left on each sub-assembly until internal tray supports in the style of a cruciform had been fitted, after which the external rings could be removed. When the vessel was fully assembled, the stiffening rings which had been previously used in the initial stages of the fabrication again came into use. These were placed around the vessel at predetermined points and at these rings jacking brackets were fitted. The vessel was then raised from the roller bed and bolster bogies, each weighing 10 tons, for transporting the vessel were placed at calculated positions underneath. The vessel was then lowered on to the bogies and secured.

Problems of a somewhat different nature faced W. P. Butterfield Ltd. in fabricating a road tank in pure nickel for I.C.I. Billingham Division. Believed to be the largest yet made in pure nickel, the tank has a capacity of 3,245 gal. gross, with overall dimensions of 22 ft. 10 in. long by 5 ft. 6 in. diam. by 10 s.w.g. The tank was insulated with *Fibreglass* and covered with 18 s.w.g. aluminium sheets.

If nickel is heated to a temperature greater than

500°C. in the presence of sulphur in a neutral, reducing or oxidising atmosphere, it suffers severe loss of ductility. This is due to the formation of nickel sulphide at the grain boundaries, which reduces cohesion, leading to cracking on subsequent hot or cold working. Throughout the fabrication of this tank, careful precautions were taken to ensure complete freedom from sulphur contamination. All nickel materials were protected during storage and fabrication, cotton gloves were worn by all operators and thorough cleaning of all weld surfaces was achieved by degreasing with carbon tetrachloride and wire brushing with stainless-steel wire brushes.

A chemical engine?

THE possibility of getting mechanical work directly from chemical reactions was one of the intriguing vistas opened up by Dr. H. W. Melville, F.R.S., secretary of the D.S.I.R., in his Kelvin lecture before the Institution of Electrical Engineers. The system would be based on the use of ion-exchange fibres which resemble animal muscle in mechano-chemical behaviour. The precise chemical structure of the fibre is unknown, but it is made by mixing high-polymer molecules containing acid groups with those containing alcohol groups. These fibres can be made to contract when in contact with one type of solution and expand when in contact with another, thus performing mechanical work. Thus the fibre swells in contact with an acid. If the acid medium is replaced by an alkaline medium the hydroxyl ions will react with the H^+ ions attached to the outside of the fibre to yield water and the fibre will be left with a negative electrical charge. These charges cause the molecules to stretch by electrostatic repulsion. Finally the fibre can be brought back to its original state by placing it in an acid bath. Thus mechanical work is done as a result of the neutralisation of an acid by a base with the production of water.

The efficiency of this mechano-chemical system is only 1%, said Dr. Melville, but no real attempt has yet been made to get the optimum from such fibres for this kind of engine and no doubt a much better performance could be achieved. After all, even modern locomotives operate at an efficiency of only about 5%.

Another possibility is that of getting much stronger synthetic fibres than those made so far. Even the strongest natural and synthetic fibres have a tensile strength of only about 10 g./denier and, surprisingly enough, this figure seems to be independent of chemical constitution. From this it might be thought that the figure represents the ultimate strength of this kind of matter, *i.e.* the strength of the chemical bonds comprising the fibre. But in fact fibres have only about one-hundredth of the strength calculated in this way. Even assuming that the fibre breaks by the chains sliding past each other, the molecules of the polymer remaining intact, actual strengths are less than theory predicts. 'It is therefore tempting to speculate that much stronger fibres might yet be produced,' Dr. Melville concludes.

New nickel refining process gives sulphur and selenium as by-products

A NEW process for the electrorefining of nickel, developed by the International Nickel Co. of Canada Ltd., makes use of the direct electrolysis of nickel matte. This contrasts with the usual electrorefining methods, including those employed in the nickel industry, in which a metal anode is used. The new Inco process eliminates high-temperature oxidation and reduction operations, with attendant losses of metals and sulphur and selenium. Instead, nickel sulphide of low copper content from the Bessemer converter or other source can be cast directly into sulphide anodes and electrolysed for the production of high-quality nickel. Another unique feature of the process is that it permits, for the first time in nickel refining, the commercial recovery of elemental sulphur and selenium as valuable by-products, in addition to cobalt and precious metals conventionally recovered.

The process is in commercial operation in a section of the company's Port Colborne, Ontario, nickel refinery. Sulphur-selenium separation is accomplished in a 100-ft.-high fractionating column of special design.

The interesting possibilities of the new method were first demonstrated in Inco laboratory tests in 1951, when a small piece of cast nickel sulphide was electrolysed. It corroded smoothly the nickel and other base metals passing into solution, leaving a precious-metal-bearing anode sludge containing 97% elemental sulphur.

A number of obstacles to the recovery of sulphur of high purity from the sludge were resolved by laboratory and pilot-plant investigations. These studies, conducted jointly with Blaw-Knox Co., resulted in the construction of a novel 100-tons/day sulphur fractional distillation unit. The sulphur from this unit contains less than 5 p.p.m. of selenium and has an unusually low ash and bitumens content. The selenium residue is shipped to Inco's copper refinery at Copper Cliff, Ontario, where it is processed for recovery of pure selenium.

New use for ammonium nitrate

THE new nickel refining process discussed in the foregoing item is just another example of the initiative and virility of Canada's industries, which are the subject of a special article in this issue. Another is the new use that is being made of ammonium nitrate following the discovery that this chemical constitutes a powerful explosive when sensitised with carbonaceous material such as finely ground coal dust or lamp black, or by hydrocarbons such as fuel oil. In Canada, supplies of the material are now being made available by Canadian Industries Ltd. from warehouses strategically located across the Dominion. Not only will the new material effect a substantial saving in many blasting operations but it will open an important slice of the explosives market to manufacturers of chemical fertilisers who now make ammonium nitrate for fertiliser use.

Ammonium nitrate has been used as an ingredient

in the manufacture of commercial high explosives since about 1867, but it was not until after World War 1 that efforts were made to introduce it as a chemical fertiliser and, indeed, little interest was displayed in it as a fertiliser until World War 2 when a ' prilled ' form possessing free-flowing characteristics was developed. In the immediate post-war period substantial production of ammonium nitrate was attained and its explosive qualities demonstrated in the unfortunate Texas City disaster of 1947. Rising production costs in quarrying and open-pit mining have provided an effective stimulant to the use of lower-cost blasting agents and the employment of ammonium nitrate for this purpose has progressed rapidly. It is usually mixed with fuel oil on the job and has so far proved most effective where the work is dry, the holes relatively large and the formation easy breaking.

We've got company

SERVING, as we do, the numerous industries in which chemical engineering plays a part, we are constantly aware of the fact that, as a journal of the Leonard Hill Technical Group, CHEMICAL & PROCESS ENGINEERING enjoys the company of 15 other journals each of which also serves one or more industries. For readers who would like to know more, we commend to them a booklet that has now appeared with the title ' This is Leonard Hill ' which reveals the inspiring story of a young Royal Flying Corps officer—Capt. Leonard Hill—who, as he re-entered civilian life at the end of the first world war, decided that he could make his contribution to the new age which was dawning by spreading new knowledge of applied science through the published word. A brave decision this, for at that time there was comparatively little technological education as we now know it. Many scientific and technological institutions and societies which today foster our industrial activities were unborn. But in the research laboratories of the universities and in industry itself, discoveries were being made which were to transform the industrial scene.

The booklet records that it was characteristic of Leonard Hill that his first publishing venture was in a field of technology not only almost unknown at that time but almost unnamed—chemical engineering. Industry in those days had little time for what is now widely recognised as the fourth primary technology. In spite of these unpromising circumstances Leonard Hill went ahead and published the ' Chemical Engineering and Chemical Catalogue,' which became recognised as a quite revolutionary work, drawing the support and co-operation of eminent chemical engineers. The 24th edition, completely revised, is appearing under the name ' Chemical Engineering Data Book.'

From the outset the possibilities of the penetration of chemistry into industry fascinated this pioneering technical publisher. Within eight years, he had begun to publish a range of technical books besides three exceptional monthly periodicals. Book followed book and periodical followed periodical, and one of the first important post-war milestones was the launching of a chemical engineering monthly, now known to the world's industries as CHEMICAL & PROCESS ENGINEERING. This developed originally from a journal acquired before the war with the name *Indian & Eastern Druggist*, but in 1949 was completely changed and appeared as *International Chemical Engineering*, the name later being changed to CHEMICAL & PROCESS ENGINEERING. With the firm backing of an organisation that pioneered in chemical and chemical engineering publishing, it went on to achieve the world-wide sale and influence it enjoys today.

This was by no means the last of the journals to be launched by Leonard Hill. Food, agriculture, nuclear energy, applied chemistry, pharmaceuticals, surface coatings, petroleum, building, chemical engineering, automation, fibres, textiles—these are the growth industries of the modern world, and all are well served by the Leonard Hill Group. For over 30 years they have created and maintained new and high standards in technical publishing.

Centenarian scientist

ON his 100th birthday, celebrated recently, Sir James Swinburne was able to look back on a lifetime's work as a distinguished engineer and one of the world's pioneers in the field of synthetic resins. His original work on phenolic resins at the beginning of the century made a major contribution to the development of the modern plastics industry.

At the turn of the century, when he was practising as a consulting engineer, he was shown a piece of synthetic resin made by an Austrian chemist named Luft. This resin had been made by reacting phenol with formaldehyde and was handed to Mr. Swinburne as an interesting but useless novelty. He became interested in the possibilities of using Luft's process to yield a useful material and, after two years of research, found that he could produce phenol formaldehyde resin using sodium hydroxide as a catalyst. However, he delayed applying for a patent on the process in the hope that he would discover a better method. When he eventually went to the Patent Office to register his process, he found that he had been anticipated by one day. A brilliant Belgian chemist working in the United States had just patented a similar process. His name was Dr. L. H. Baekeland, whose name has since become renowned through the name *Bakelite*, given to the phenolic formaldehyde resin he produced.

Undeterred, Mr. Swinburne continued his work in England and within a short time he produced a resin which set hard and clear and which made an excellent lacquer suitable for the protection of brass and other metal surfaces. This lacquer was named *Damard*, and in 1910 a company was formed to produce it, this company later extending its activities to other products and eventually combining with two other companies to form Bakelite Ltd.

Safe Design and Operation of Chemical Plants

By E. W. Jackson, A.M.C.T., A.M.I.Chem.E.

Consideration of the safety aspects of a plant or process at the design stage has a special importance for the chemical engineer, while suitable safeguards during operation are no less important.

IN a chemical works, apart from the normal works hazards, there are additional dangers to consider which may arise from the presence of one or a combination of the following: toxic solids, liquids, vapours and gases; inflammable solids, liquids, vapours and gases; explosive substances; and materials which have a corrosive action on the skin. It is therefore important to maintain a high degree of safety consciousness where such substances are handled.

Design

The place to consider safety in any new chemical works or process is at the design stage, and the chemical engineer engaged on the design should make himself familiar with the hazardous properties of all raw materials, intermediate products, finished products and chemical reactions.

The guiding principle in the design of a plant for the handling of dangerous materials should be to keep the materials contained within the plant and not to allow them to pollute the operating area. In some cases this will apply to the whole plant, in others to a portion of the plant. The method of containment adopted will depend on the circumstances; in many instances it will be decided by economic considerations, but any plant which depends for its safe operation on the continuous wearing by workers of protective equipment, on high rates of ventilation or on limitation of the time workers are engaged on the process, is badly designed.

It should not be possible for a worker to make a mistake in operating the plant which will lead to a hazardous situation, and it is the responsibility of the chemical engineer to see his design is such that this cannot occur. The designer should see that safety devices, including explosion reliefs and flame arrestors, are incorporated in the plant where necessary. Instruments are marketed which will give an instantaneous indication of the concentration of some toxic and inflammable substances in air. Where possible, this type of instrument should be installed coupled to an alarm system to draw attention to excessive concentrations of the dangerous material. For these instruments to be of value the air sampled must be representative of that to which the workers are exposed.

Another safety aspect to be considered at the design stage is the removal of solid, liquid and gaseous waste products from the process, and suitable precautions are necessary to ensure that land, water and atmospheric pollution cannot occur.

Where a safety officer is employed he should take part in the discussions on plant design, and he should have an opportunity to examine flow sheets, plant diagrams and layout drawings so that he may point out where the safety of the plant can be improved. The safety officer will also check that the various statutory safety requirements have been complied with. He will also give valuable assistance in the writing of safety and operating instructions.

Operation

The safe operation of a plant is a part of good management, and the first essential is adequate training of operational and maintenance staff. The training on the job should be supplemented by lectures on the process, the hazardous properties of the materials to be handled and the methods of handling the materials in a safe manner. Where it is possible, practical demonstrations of the hazardous properties of the substances to be handled can be made a useful part of the training scheme.

First-aid equipment and protective equipment which may be required for certain operations should be regularly inspected. It is the supervisors' responsibility to see that workers comply with the safety instructions for the process and that protective equipment is worn when necessary.

CPE this month makes a special feature of:

SAFETY AND FIRE PREVENTION

Where instruments are not installed to detect concentrations of dangerous substances in air, chemical analysis of the air should be a routine measure. Here again, for the results to be of value, the air sampled for analysis must be representative of that to which the workers are exposed.

The limit of inflammability of gases and vapours in air may be determined with reasonable accuracy, but when considering toxicity of substances in air the limits cannot be so clearly defined. Figures are quoted in the literature for the maximum allowable concentration in air of some toxic substances, and many of these figures are based on insufficient evidence. Even in cases where the figures for maximum allowable concentrations are based on what may be regarded as adequate information, it should be recognised that the susceptibility of individuals varies, and the reaction of the same individual may vary from time to time.

It is better to use figures for maximum allowable concentrations as a guide and not use them indiscriminately as working levels. Maximum allowable concentrations should be based on a time of exposure. Some toxic substances can be tolerated for short periods in air at relatively high concentrations compared with the allowable concentration for continuous work. All too often one sees figures quoted for the allowable concentration of toxic substances without any reference to exposure time.

Accidents

There is always the danger with certain processes that in the event of fire or other mishap the remainder of the works or adjacent premises may be endangered. In these cases a plan to deal with an emergency is desirable; selected personnel should be trained to cope with the situation, and the training should be repeated at regular intervals.

Whenever an accident or dangerous occurrence takes place the circumstances should be fully investigated. All accidents and dangerous occurrences have a cause, and something can be learned from every investigation to enable recommendations to be made for improving the safety of the process.

Safety in a Modern Chemical Factory

By R. D. Bromley, B.A., A.C.I.S.

(Personnel Manager, Price's (Bromborough) Ltd.)

Installation of a completely new, continuous process for the production of stearines and oleines (see CHEMICAL & PROCESS ENGINEERING, *July* 1957, *pp.* 280-282) *brought to the Price's (Bromborough) Ltd. factory not only increased efficiency but also increased problems of safety. Details of the company's well organised system of accident and fire prevention are given in this article.*

SINCE the end of the war, the factory of Price's (Bromborough) Ltd., near Birkenhead, has been undergoing a remarkable transformation as old, traditional batch processes have been superseded by the latest continuous process plant, and new roads and new buildings have taken the place of the old.

After the opening of the first *Emersol* plant in 1951, the rate of change increased and reached a peak during 1957 with the opening of the second *Emersol* plant and the closing down of the old pressing process, familiar to generations of Price's employees who gained their livelihood at Bromborough Pool. During this period of rapid technical change, the company's mechanical, electrical and building departments were stretched to the limits of their capacity. With contractors assisting in the demolition and removal of old buildings and plants and the erection of new buildings, it would have been easy and perhaps understandable if technical developments had temporarily overshadowed the need for the factory safety organisation to change and develop at a similar pace. However, with a strong lead from top management the need for increasing vigilance in safety matters has not been overlooked at Price's and strenuous efforts have been made by management and employees alike to eliminate hazards and to reduce the number of accidents occurring in the factory.

Safeguards against toxic and fire hazards

The solvent separation process operated by Price's (Bromborough) Ltd., under licence from Emery Industries Inc., Cincinnati, U.S.A., is the only one of its kind in the United Kingdom, and in itself presented the company with a number of formidable safety problems. To ensure protection for the staff from toxic solvent vapour, both *Emersol* plants are guarded by a specially designed methanol detector. Stringent precautions are exercised to prevent an outbreak of fire and each of the two plants has its own separate fire alarm system operating by means of fusible links which are designed to melt at a fixed temperature and to discharge a bank of carbon dioxide cylinders.

In addition, each plant is covered by the general factory fire alarm system, the installation of which was completed in 1956 by Associated Fire Alarms Ltd.

To ensure that these two vital plants are not jeopardised by the natural human tendency to take automatic alarm systems for granted, careful tests are made every week of these systems and the operatives are given fire drill instructions every three weeks, so that the building may be rapidly evacuated in an emergency. To enable the building to be entered after a discharge of the carbon dioxide cylinders, special breathing apparatus is provided and the operatives are trained in its use, so that in an emergency every man working on the process knows precisely what to do and how to do it.

Employees working in the *Emersol* plant receive a free issue of safety shoes in which no ferrous metal has been used, and all electrical equipment in the building has been flame-proofed to obviate sparking. As a further safety measure only a strictly limited number of employees is permitted to enter these buildings, and then only after matches and cigarette lighters have been surrendered and the employees' names entered in the register provided at the entrance.

Methanol detector

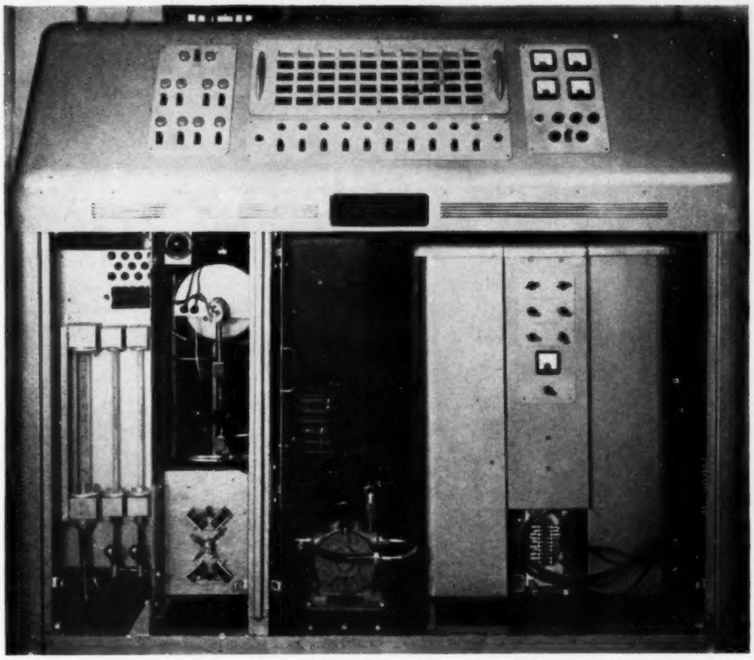
The methanol detector serving both plants, which are housed in adjacent buildings, stands guard day and night over the health of the employees, ready to sound a strident hooter should a predetermined concentration of methanol in the air be reached. This detector analyses a sample of air from one of ten positions in each building at intervals of 108 sec. Each station is tested in turn and the cycle is repeated every 18 min. When the methanol concentration reaches 200 p.p.m., and again at 1,000 p.p.m., the detector gives visual warning signals, and when the latter concentration is reached the hooter sounds continuously.

At the sound of the hooter a strict drill is adhered to to ensure the reduction of the methanol to a harmless level and those responsible for the maintenance and management of the plant are also notified. The methanol level at which this drill is carried out is well below that at which the methanol would be dangerous to health, but to underwrite any possible failure of the detector, notices are prominently exhibited in the building describing the symptoms of methanol poisoning, so that immediate relief may be sought by an affected employee in the unlikely event of the complete failure of the system.

Fire precautions

Since the general fire alarm system was installed every employee has received individual instruction in the handling of fire extinguishers, and every section of the factory and offices has had at least one fire drill with the fire-alarm bells realistically sounding in the selected area, without prior notice, and the employees evacuating the area with all speed.

In addition to this extensive alarm system, firemen patrol the factory and office 24 hours per day and volunteer departmental fire teams receive regular and frequent training in emergency fire fighting. A senior staff fireman is responsible for ensuring that all



Methanol detector with front plates removed to show the interior. Samples of air are drawn in and tested automatically at fixed intervals. An alarm sounds if a dangerous concentration of methanol is detected.

fire-fighting and breathing apparatus is regularly inspected and tested for efficient working.

Role of safety officer

Compliance with the Factories Acts is regarded as a minimum necessity at Price's where the Factory Inspector is welcomed as one who seeks to help and advise rather than as a Government enforcement officer. The safety officer at this factory is not regarded as a scapegoat on whom the responsibility for safe working in the factory is thrust by a busy management. Safety is recognised as being an integral part of every employee's job on every level, from factory operative to managing director, and employees are encouraged to make suggestions to improve their working conditions and to draw the attention of their chargehand or supervisor to any hazards they encounter in the course of their work. Nevertheless, a practised eye and a mind trained to notice potential dangers are valuable aids in detecting hazards with which the employee may be so familiar that he fails to recognise them as a source of danger to life and limb. It is here that the safety officer, who was previously a production supervisor for a number of years, is of the utmost value.

By regular inspection of every section of the factory he ensures that hazards are brought to light and, by discussion with the appropriate supervisor or manager, eliminated wherever possible. Where a problem cannot be dealt with immediately, he discusses it with the engineering department to ensure that effective measures are taken to reduce or remove the potential danger and, in order that a separate channel may exist whereby awkward safety problems or untoward delays may be brought to the attention of the senior management, the safety officer is responsible directly to the personnel manager.

Plant development and safety

At Price's it is recognised that safety starts at the drawing board and the project engineers welcome the safety officer to discuss details of plant development, realising that it is easier and cheaper to make necessary alterations at this stage than when the plant has been erected and is working.

During the transformation of the factory, advantage has been taken of the opportunity to combine safety with efficiency and, for example, the sulphuric acid distribution system has been completely replaced by a new gravity feed system which has greatly reduced the possibility of acid leaks. The face shields and saline solution

bottles provided are inspected each week and replenished whenever necessary by a member of the personnel department, so that these essential facilities are always ready for immediate use.

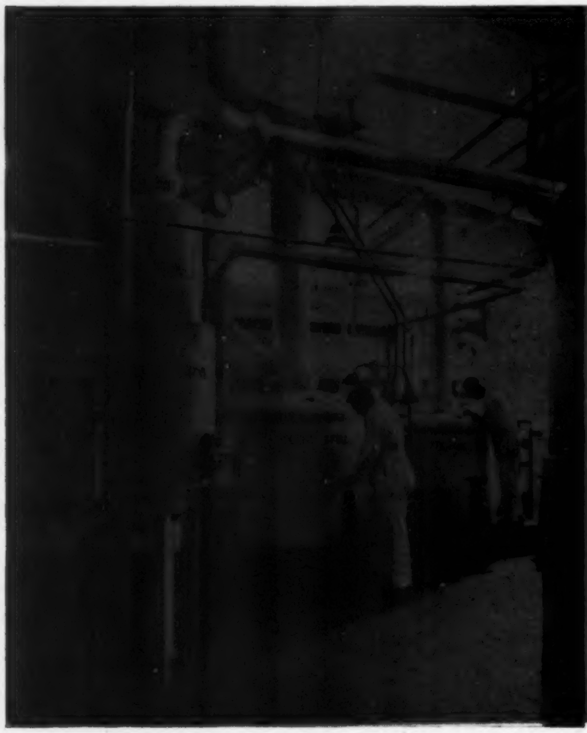
Personnel protection and welfare

In order to ensure that employees receive adequate protection where hazards cannot be completely eliminated, a schedule of protective clothing requirements has been drawn up after consultation with the appropriate departmental managers and supervisors and after reference to each individual's job description. The majority of the employees in the factory are supplied free by the company with two sets of overalls which are laundered and repaired at the company's expense. In addition, special reserves of safety equipment, goggles, rubber boots and safety belts are held in the protective clothing stores to meet, without delay or formality, any extra demand for safety equipment which may arise from time to time.

In a factory the primary purpose of which is the production of organic chemicals derived from oils and fats, facilities for personal hygiene must be first class to obviate any risk of dermatitis. Accordingly the company have completely redesigned their central cloakroom, which now provides pleasant and efficient washing facilities, showers and foot baths, and separate locker accommodation installed over steam-heated pipes, for use by the factory employees. Additional facilities have been provided in parts of the factory for those employees whose work is located at some distance from the central cloakroom, and barrier creams are freely available for those employees whose work necessitates some additional safeguard.

Any employee at Price's who may be injured or fall sick during the course of his work knows that he can rely on speedy and effective attention at the health centre, which is staffed by qualified nurses throughout the day and night, and under the general supervision of the company's medical officer. As direct telephone communication is maintained between Price's (Bromborough) Ltd. and the local fire brigade and ambulance unit, a serious case of illness or accident may be dealt with almost immediately by an ambulance which can reach the factory within five minutes of a request for help and deliver the patent to hospital with all speed.

Complementary to this system for treating employees at the company's health centre is the training and organisation of the St. John Ambulance Brigade, whose enthusiastic members regularly give up part of their spare time to prepare themselves to deal with emergencies in the factory which may require immediate first-aid treatment, before the health centre can take over.



An interior view of part of the new 'Emersol' plant for the selective solvent separation of fatty acids

Factory's safety record

Evidence of the results of the efforts made to ensure a high standard of safety at Price's may be seen from the following comparison of frequency rates for the five years 1953 to 1957:

No. of lost-time accidents per 100,000 hr. worked

1953	1.19
1954	1.40
1955	1.41
1956	.99
1957	.51

During 1954 there were 27 lost-time accidents in the factory and since then the number has reduced from 26 in 1955 to 18 in 1956 and to 8 in 1957.

The frequency rate for 1957 is the lowest ever recorded at Price's and compares very favourably with the frequency rate for the industry. It represents the result of continuous co-operation between the factory employees, their supervisors and managers, the safety officer and the engineering departments, founded on a recognition that most accidents are avoidable evils from which no one gains and all must lose, whether it be in terms of health, wages or departmental efficiency. It is recognised that the price of safety is constant vigilance and that when every possible measure has been taken to make the factory safe, it remains true that accidents can still be completely avoided only by the development of safety consciousness among all grades of employees.

In order to promote such safety consciousness, talks on factory safety, supplemented by films, where appropriate, are given from time to time by the safety officer to the junior process workers and apprentices and to other groups of workers as the occasion demands.

The management of the company believes that a safe factory is an efficient factory and that time, effort and money spent in promoting safety consciousness among employees, and improving working conditions in the factory and offices is worthwhile expenditure. In the long run keen competition can be met only by a labour force free to concentrate on producing the highest-quality materials at the lowest possible cost, without the disturbance and loss caused by avoidable accidents.

Safety in the Use of Chemicals

By H. Allen

Although most chemicals are the subject of safety codes where they are involved in industrial processing or application, new uses and some new materials make it essential for management to exercise constant vigilance to maintain a comprehensive code of accident-free working.

THIS article takes as examples a number of chemicals now in wide and increasing use, as follows:

Amines

The amines are being put to increasing use as curing and hardening agents. As components of resin compounds they are applied in considerable variety. With resins they appear in such processes as moulding, casting, laminating and so on and in the plastics and glass-fibre industries they have an enormous future. Prolonged exposure to even relatively low concentrations of the catalysts may produce a form of dermatitis. Amines are alkaline and in contact with the skin can cause burns. Those which have a dye base can cause skin discoloration.

There is a difference in individual response to the amines where sensitivity is concerned and, if any worker shows strong sensitivity, he should be permanently removed from exposure because the sensitivity will be a fixed pattern. Such tests as have been made seem to indicate that fair-skinned individuals are more sensitive and those with thin rather than coarse skins, but the proof is not yet conclusive.

Tests have shown so far, however, that contact with the amines does not produce any form of acute poisoning; exposure means eye, skin and mucous membrane irritation. Generally speaking, then, they are innocent enough, but a system of precautions is advisable, especially where their use is integral in a fabricating process.

Ventilating systems are essential. All operations which involve mixing and applying should be hooded and there should be exhaust ventilation systems for the whole work area. Every machine, oven and area should be thoroughly exhausted. In this connection it must be appreciated that working in raised temperatures increases the hazard. Curing, for instance, is normally done in ovens at temperatures from 160 to 300°F. and it is necessary to hood such ovens so as to exhaust any amine vapour that may be released by the high temperature.

Training of operatives dealing with the amines in personal hygiene is an essential part of a safe working code. It is essential to reduce skin contact to a minimum and therefore workers should wear gloves, aprons, etc., and should use barrier creams. Provision of showers, washbowls, mild soap and so on should be generous. If there is, despite precautions, accidental contact, eyes or skin should immediately be copiously washed with water. Where there is a risk of splashing in any process some form of face shield is essential. It can usefully take the form of a cellophane sheet across the face of the operating booth.

The amines present another potential hazard—that of fire. The free amines are flammable liquids. One of their most frequent uses is with solvents for cleaning machines and the standard procedures for fire protection must therefore be applied. In this connection, storage is important from the safety angle. Safety-type containers should be used. Carbon dioxide fire extinguishers are the most effective kind.

With the many recent developments of the use of the amines as components of epoxy and isocyanate resin formulations, there has been considerable clarification of the hazard problem. It has been shown under repeated tests, for instance, that when the resin and catalyst is completely unified the sensitivity risk vanishes. But it can return under certain conditions. If, for instance, any process follows which regenerates the vapour, then the risk is revived. Such processes include sawing, milling, contact with solvents or grinding of the hardened material.

The amines thus present no very great problems. They can be made entirely harmless and easy to deal with, but only if the code of safe working with them caters for all their latent hazards. It will not be a code that causes any safety engineer a major headache.

Fluorides

Fluorine compounds are now so widely used in industrial processes that to list their many applications is to touch on a dozen or more trades. Fluorspar and cryolite are extensively used in the pottery industry; hydrogen fluoride in foundries for pickling steel castings, and the foundry trade also needs cryolite as a flux and potassium fluoborate in sand mixtures for aluminium and magnesium castings. Welding fluxes contain fluorine, and fluorides are used in timber preservation; the fertiliser industry, the glass industry, mining and brewing—all these industries utilise inorganic fluorides in some compound or another. Hydrogen fluoride, calcium fluoride, sodium fluoride, ammonium bifluoride and hydrofluosilicic acid (used in the laundry trade to neutralise the alkali of soap) add to the long and impressive catalogue.

It is as well then to analyse the properties of the fluorides from the safe working angle. Assessing the hazards will educe the following data:

(1) There is a toxic risk with some of the complex fluorides and a risk of burns or mucous irritation through contact with the liquid and solid acidic compounds.

(2) An explosive risk occurs under certain circumstances when solutions of acidic compounds attack metal containers and thus liberate hydrogen.

(3) There will be irritation of the eyes and nose as a result of prolonged exposure to relatively high concentrations of fluorides which readily produce hydrogen fluoride on exposure to moisture at room temperature.

(4) Irritation of the upper respiratory tract may follow on exposure to the dust of the soluble fluorides.

(5) Chronic poisoning may arise (though it rarely does) through prolonged exposure to the dust of fluorides of very low solubility.

(6) The skin will toughen and its tissues be destroyed by prolonged contact with solutions of hydrofluoric acid.

To list the hazards is not to magnify their potential; it is simply to assemble the facts. A comprehensive safety code can reduce the hazards to nothing and a completely safe working system with the fluorides can be established if the necessary precautions are defined. As is usual with chemicals, the allowable concentrations are key points in the code of safe handling. There is not much empirical literature on the subject, but research both in Britain and in America leads to the acceptance of the figures given in Table 1 as being reliable maximum allowable concentrations for some fluorides commonly in use.

At the levels in this list work is quite safe. However, it must be stressed that these concentrations are *limits* and not ideals to aim at. In each case the concentration should be kept as far below the M.A.C. as processing needs will permit. Nor does the achievement of safe working levels absolve management from the need to train all operating personnel in handling and storage methods, while it is essential that the wearing of personal protective equipment be the rule. Neoprene gloves are undoubtedly best for use where anhydrous hydrogen fluoride is involved. An important item in the safety drill is the cleaning of all tools and small equipment which have been used in the vicinity of acid fluorides. All such equipment should be washed in soda ash solution. Similarly, air contamination must be guarded against by good ventilation.

Storage is highly important. All the soluble fluorides must be so stored that they cannot come into contact with acidic substances; if they do there is at once a release of volatile hydrofluoric acid and that can be hazardous. Hydrogen fluoride is extremely soluble (its solubility in mg./100 g. H_2O is 372 at 32°F.), so that it will not readily be released from solution at room temperature. The low soluble group of fluorides such as potassium fluosilicate and lead fluoride, for instance, react extremely slowly with acids.

Dust hazards with the possibility of toxic risk is the chief problem with the insoluble fluorides such as lithium fluoride and cryolite and the insoluble ones such as zinc fluosilicate and fluosilicic acid. They are solid compounds. The necessary precautions are along standard safety practice techniques of dust control. These include local exhaust ventilation, enclosure systems, wet methods and so on.

As for the containers for storage the suppliers of the chemicals are the best advisers on that point and will be only too glad to co-operate. Steel containers are normal for anhydrous hydrogen fluoride and mild steel is standard for hydrofluoric acid. Compounds of the low solubles are usually carried in glass or wood.

When containers are being vented it is a sound safety rule to insist that the operation is not undertaken in any area where a source of ignition is present. All operators should be instructed in a definite drill for the handling of the chemicals. That way the process should be entirely without hazard.

If, however, despite detailed precautions, circumstances arise which cause an accident then first-aid treatment methods must be understood by all personnel. In the case of burns, immediate drenching with copious quantities of water is the first step. An item in the safety code should in fact include the provision of shower baths or generous supplies of water near areas where the chemicals are being handled or processed. Bottles of eye lotion (or distilled water) should also be kept handy.

Table 1. Maximum Allowable Concentrations of Fluorides Per Normal Working Shift

Compound	*M.A.C.* (*mg./cu.m.*)	*Remarks*
Aluminium fluoride	3.7	All of exceptionally low solubility
Calcium fluoride	5.1	
Magnesium fluoride	4.1	
Nickel fluoride	6.4	
Hydrogen fluoride (both gas and liquid)	2.5	
Ammonium bifluoride	3.8	These compounds easily produce hydrogen fluoride on exposure to moisture at room temperature
Potassium fluoride	7.6	
Sodium fluoride	5.5	
Boron trifluoride	3.0	
Silicon tetrafluoride	3.4	

Table 2. Properties of Alkyl Mercaptans

	Methyl mercaptan (*methanethiol*)	*Ethyl mercaptan* (*ethanethiol*)	*Butyl mercaptan* (*1-butanethiol*)
Solubility in:			
(*a*) Water	Slight	Slight (1.7%/20°C.)	
(*b*) Ethanol	Soluble	Soluble	
(*c*) Ether	Soluble	Soluble	
Nature	Colourless gas or liquid depending on temperature	Colourless, mobile, volatile liquid. Explosive limits, 2.8 to 18.2% by volume	Colourless, mobile, volatile liquid
Density (20°C.)	0.868	0.84	0.83
B.P. (°C.)	7.6	34.7	98
M.P.	−123	−121	−116

Alkyl mercaptans

Properties of this group of chemicals are listed in Table 2. All three compounds are inflammable, so that the liquid and concentrated vapour present a fire hazard.

Ethyl mercaptan, used in some laboratory processes and as a chemical intermediary, is one of the most readily perceptible compounds in the chemical field. A concentration in air of 0.04 g./cu.m. is perceptible and that means that 0.01 mg. will odorise 230 cu.m. of air. At high concentrations the vapour is highly irritant. In fact the malodorous properties of the mercaptans as a group have caused many 'neighbour' complaints when they have been used at a chemical plant in a populated area.

Except in the case of excessive contamination, however, the occupational risks from the volatile alkyl mercaptans are restricted to fire and explosion risks and to relatively minor throat, eye and nose irritation. The toxicity and occupational risks from the mercaptans are much less than those presented by hydrogen sulphide, but there is a marked anti-social element

in the mercaptans associated with their objectionable odour. That means that the safe working code will need to incorporate measures for keeping them under control as atmospheric contaminants. It should be standard practice to ensure destruction of mercaptan residues on equipment as soon as possible. Furthermore, processing at high temperatures should be avoided and there must be perfect sealing of containers, while operators must be trained to carry out exemplary personal hygiene.

As a general characteristic of the group and like most other sulphur-containing aliphatic compounds, the mercaptans impart a bitter taste to food and water, so that there is little risk of toxicity that way, but clothes can be easily contaminated and the provision of protective wear for operators should be an item in the safe working code.

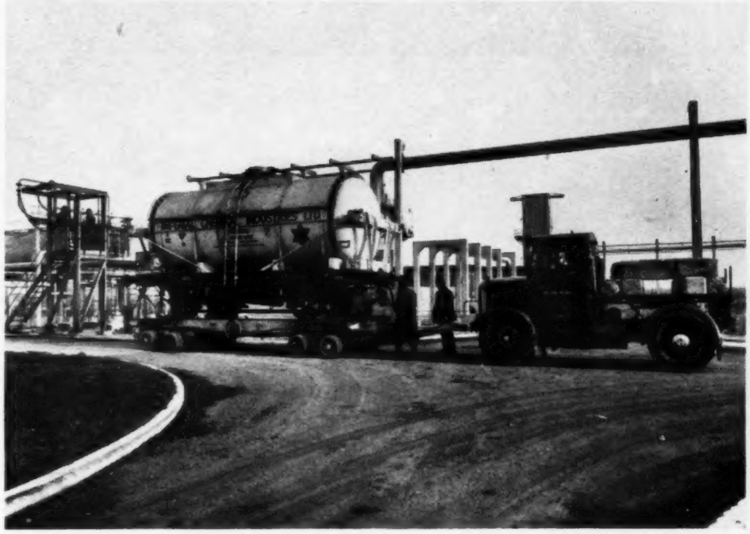
Iodine

If application of the mercaptans is likely to be restricted because of the malodorous element, that of iodine is likely to extend. An oxidising agent, iodine is used in the manufacture of aniline and phthalein dyes, iodates, iodides and organic compounds. It is much used in leather manufacture, in process engraving, paper industry, lithography, and as a catalyst for the alkylation of primary amines. Hazards are quickly listed. Exposure to vapours is harmful to the eyes, nose and chest and there is a marked dermatitis risk in both the solid and vapour forms.

First rule in the safety code must be that no handling with skin contact be allowed. Ventilation of work atmosphere is essential. If accidental spills occur, sodium thiosulphate or dry sodium carbonate should be used to neutralise the iodine. The generally accepted M.A.C. for iodine vapours (for a normal working shift) is 0.1 part of vapour per million parts of air. Control systems by local exhausts at work centre will cover the vapour risk.

The standard test for determining the concentration of iodine vapour in air is to disperse an air sample by a glass scrubber in an iodine-absorbing medium. The amount of absorbed iodine is then assessed by standard volumetric process, using sodium thiosulphate and a starch iodide indicator.

Face shields should be worn by operators working with iodine and, as usual, training of operators in the hazards and their control should be the basis of all accident prevention.



Here is how the special trailer at Wilton, with a rail tanker aboard, finishes the last 50 yards of its journey to the butadiene loading point, seen on the left.

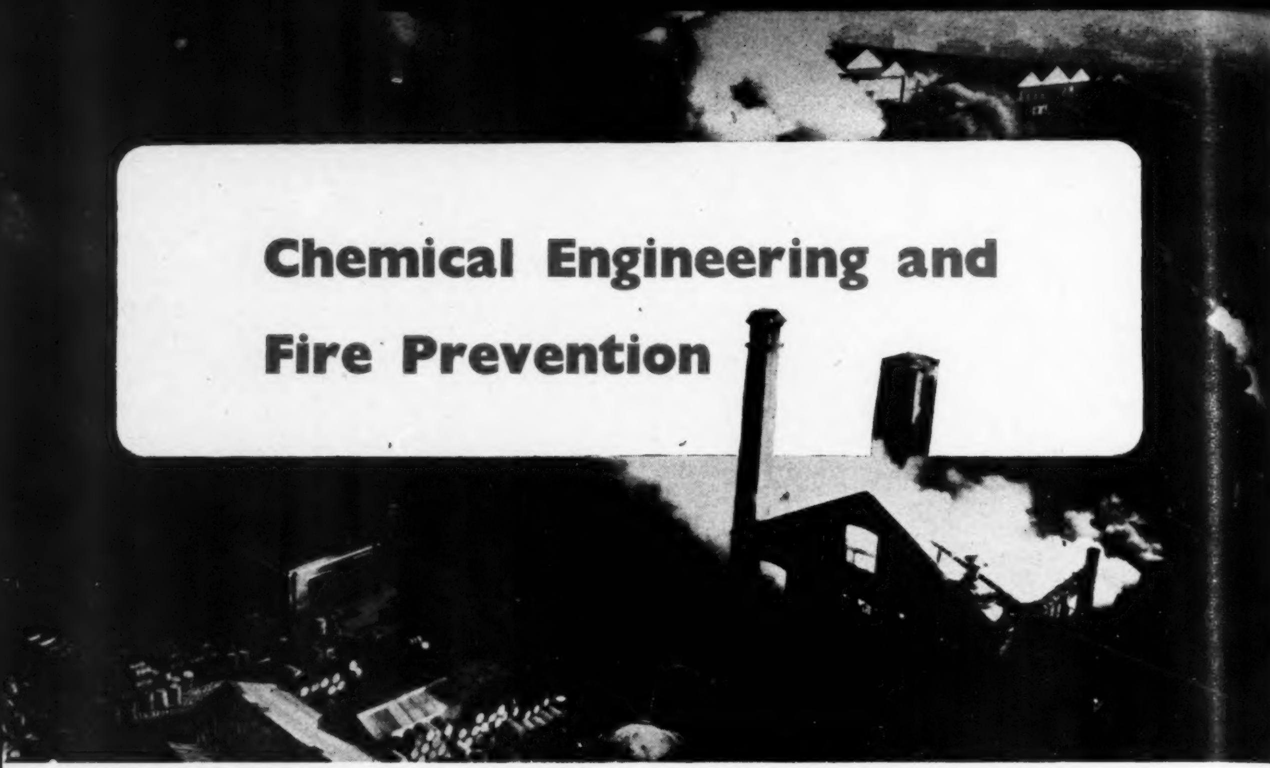
Mobile railway siding for hazardous loads

Faced with the problem of moving butadiene safely and efficiently from its loading point to the nearest 'rail-head' within the works, the transport department of Imperial Chemical Industries Ltd. at Wilton has devised, in conjunction with its makers, an ingenious trailer which serves as a mobile link for the rail tankers in which the gas is carried to Italy.

Movement of the highly inflammable gas to the Continent by road was precluded because Ministry of Transport shipping regulations did not permit it to cross the Channel by the normal passenger-carrying road-vehicle ferry service. So it was decided to use rail transport, and this created several headaches. The butadiene plant was not equipped for rail access. Not only would it have been uneconomical to connect the works rail sidings to the plant, but also the need for safety precluded the use of a locomotive in the restricted area in which the plant lies. For the same reasons a pipeline run out from the plant to the existing railhead was not considered a safe or practicable proposition. The transfer of the chemical from road tanker to rail tanker at the railhead was also undesirable for safety reasons.

What was, in effect, a mobile railway siding which could be hauled by road tractor within the works was the apparent answer, and the result was a 35-ton-capacity unsprung 32-wheeled solid-tyred trailer, with rails for the railway tankers incorporated in the main frame members, which is capable of negotiating tight corners in any part of the vast Wilton works. Hauled by a Scammell four-wheeled tractor, the trailer was built by R. A. Dyson & Co. Ltd. The outfit travels at an average speed of 5 m.p.h.

For the last 50 yd. of its journey to the butadiene loading point the tractor is detached from the trailer, turned round and connected nose first. It then pushes the trailer backwards to the loading point. At this stage, the Scammell normally leaves the trailer and tanker to be loaded, and goes about its normal duties with a 20-ton articulated low-loading trailer.



Chemical Engineering and Fire Prevention

(Contributed by the Fire Offices' Committee, Fire Protection Association)

WHILE sound design can go a long way towards minimising the fire hazards in a plant or process, there is a need at all times for vigilance in the operation, maintenance and administration of plants so that the good effects of careful planning and design are not wrecked by some act of negligence or thoughtlessness. In the major industry concerned, the chemical industry, it has been recorded that over 20% of fires are attributed to mechanical heat and sparks, faults in electric wire and cable, smoking and spontaneous combustion. These sources must be regarded as avoidable, and their elimination would represent the greatest contribution that could be made to fire protection.

Chemical reactions

Although fires caused by chemical process reactions are sometimes due to the presence of foreign materials, some reactions are by their nature hazardous. Nitration and hydrogenation processes both evolve large quantities of heat, and oxidation reactions may be dangerous, particularly where flammable liquids are involved as in the production of solvents. Reaction vessels used for such processes should be provided with temperature and, where applicable, pressure control devices. Where violent or delayed reactions are involved, such controls should be linked to means of flooding or blanketing the plant in an emergency. Materials used in packing, jointing and insulating reaction vessels should be both non-reactive and non-combustible, and lubricants should be chosen carefully in the light of the type of reagents involved.

Risk of fire is inevitably higher when new reactions are being developed and new process methods investigated. Such work should be carried out only where an outbreak of fire could be completely controlled.

Flammable liquids

Flammable liquids in bulk must be stored only in properly designed and constructed containers, suitably bonded and located in respect of other plant and buildings. The extended use of glass in reaction vessels and pipelines handling such liquids leads to further hazards in the event of fire, and such systems must be fully protected, with provision to halt the flow in the event of fire.

Petroleum-spirit storage facilities are governed by the Petroleum (Consolidation) Act 1928, which should be consulted. As well as crude petroleum the Act covers various substances which have flash points of less than 73°F., such as benzole, petrol, petroleum naphtha, toluol, *n*-heptane, *n*-hexane, etc.

Some further considerations relating to flammable liquids are discussed under 'static electricity' below.

Flammable vapours and gases

Processes involving flammable vapours and gases should be totally enclosed where possible. If the concentration of the chemical in air is above a certain value, it will be too rich to burn and, alternatively, if ventilation is provided to remove the material, the mixture may be too lean to support combustion. A third approach is to replace air in the system by an inert gas. The method chosen will depend on practical and economic considerations.

If it is not possible to enclose the process the compartment must be so ventilated as to prevent the accumulation of dangerous concentrations of the vapour or gas. If, as is often the case, the vapour is heavier than air, the extraction system must be so designed that pockets cannot collect at ground level.

Dangerous concentrations of these vapours may travel for very large distances and be ignited by sources

The chemical engineer is concerned with the design and operation of a diversity of processes which by their nature, as well as the nature of the materials being handled, give rise to marked fire hazards. This article touches on some of the factors that must be taken into account in the design, construction and installation of plant and equipment.

remote from the apparatus in which they are produced, unless adequate enclosure and extraction is arranged.

In areas where flammable vapours and gases may be present, additional precautions must be taken to exclude or enclose any sources of ignition.

All electric motors, switchgear and other apparatus must be of an intrinsically safe or flameproof type. Lighting systems may be such that the glass cover is integral with the compartment wall, which virtually excludes the lighting equipment from the compartment. Tube lighting may be brought into the compartment through glands in the wall, with the connections and switchgear on the outside. Electric cable ducting is sometimes filled with an inert gas, or alternatively the pressure in the ducting may be kept slightly above atmospheric, so that any leaks do not result in flammable mixtures entering the ducting.

Hot pipes, ducts or surfaces should either be excluded or suitably protected. Internal combustion engines must not be used in such areas.

Where there is an explosion risk, pressure relief devices should be fitted, either in the form of bursting discs or diaphragms, or free or hinged panels. Asbestos sheet panels in roofs and windows can be useful in venting explosions, provided they can do so safely. Devices operated by the small and relatively slowly rising pressures in the early stages of an explosion can be made to discharge an inhibitor into the path of the explosion.

Other devices include gas and vapour analysing equipment which can be made to initiate precautionary measures if concentrations became dangerous.

The provision of automatic protection devices is, however, of no value if in an emergency they can be rendered ineffective by an oversight in design or by ignorance or carelessness.

Flammable dusts

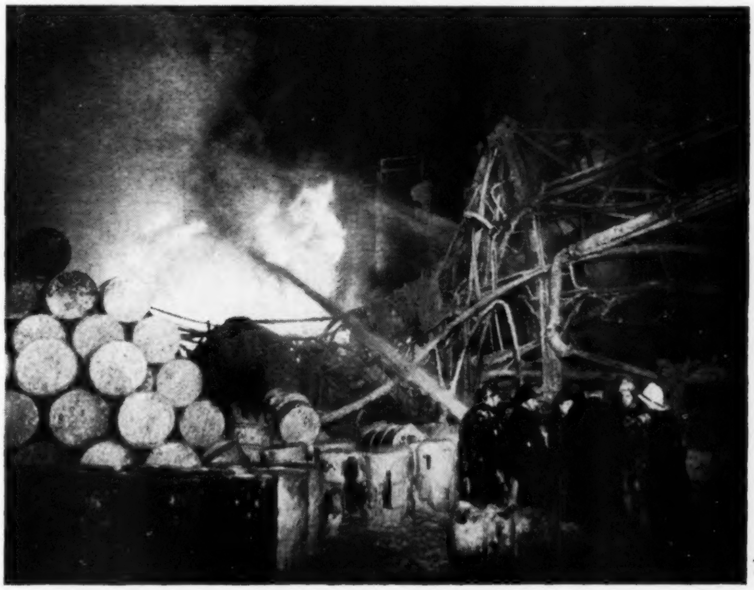
Flammable dusts may be formed from a very wide range of materials, some of which in bulk are either non-combustible or only slightly so. The properties of suspensions of such dusts in air are in many ways similar to mixtures of air and a flammable vapour. Thus there is a concentration below which the suspension will not burn, and there are limits of concentration between which the suspension is explosive.

The precautions to be taken where dangerous concentrations of dust may occur are substantially the same as for vapours.

Collections of dust on shelves and on machinery have an added hazard in that they may be the basis of a serious secondary explosion, once raised by a small primary disturbance. Such formations of dust layers and heaps must be avoided by design of plant, provision of extractors and strict observance of cleanliness. Particular attention should be paid to dust accumulations at the inlet and outlet of an enclosed dust-producing plant.

Pyrophoric dusts present a special hazard in that they ignite spontaneously. Such dusts include iron sulphide, which occurs in the production of gas, and catalytic nickel in the hydrogenation of oils.

A survey of fires involving combustible dusts makes it plain that a substantial reduction in the number of such incidents can be achieved by proper attention to the design of plant. It is necessary first to assess the danger inherent in a particular process and material. Thus there is no doubt that a rapid spread of fire can arise in some cases out of ignition of a settled dust, *e.g.* in one fire flame was described as travelling 'like lightning' along jute fluff surfaces. This flaming tendency should be determined for the dust concerned and, by correlation of this factor with the amount of radiation necessary to ignite different constructional materials, suitable materials for fabricating the plant can then be specified. In the actual design of plant, consideration should be given to reducing to a minimum the quantity of dust retained on the inside surfaces, and corners, ledges and sharp bends which promote the accumulation of dust should be avoided. The surfaces should be smooth and fabricated in a manner which would allow dust



Fighting a fire at the Lancashire Tar Distillers Ltd., Cadishead, in May 1956, when a fire broke out in a one-storey building, part of which housed naphthalene, benzole and pyridine plant. Cause of the fire is unknown, but it began in the part of the building used for naphthalene. There were three explosions during the fire, including two cylinders of compressed ammonia

deposited to slide off easily and be carried away with the stock. Careful maintenance of the plant would also contribute to reducing the fire hazard.

Static electricity

Static electricity is generated whenever there is movement of materials. Liquids flowing from one container to another or being stirred; dusts emptied from bags, or merely disturbed from a shelf; powders being mixed, ground or sieved; sheet material being processed, or conveyor belting in motion; each of these processes may generate sufficient electricity to give a spark ignition on discharge. The risk is particularly high if the materials involved are non-conductors of electricity and if they are flammable.

Where flammable liquids are handled, tanks and pipelines should be earthed in as many places as is necessary to ensure against a potential rise due to static, and electrical continuity of pipelines and associated equipment secured by bonding all mechanical joints with high-conductivity metal straps, avoiding the use of dissimilar metals. These and all equipment used for cleaning or purging tanks should also be bonded to the tank and pipework. Periodical earth continuity tests should be made from the points farthest from the earth connection.

The generation of static charges increases with the rate of flow and the lowest practicable pumping speed should be employed. In the case of liquids of high dielectric (insulating) value it is usual to restrict the rate of flow to 3 ft./sec. Excessive turbulence and consequent formation of static charges when filling tanks may be avoided by using submerged filling lines.

If an automatic level indicator is not installed a non-metallic dip stick is to be preferred, although under conditions of high electrification even this may not confer safely.

Dusts and powders can accumulate static charges in much the same way as liquids. Electricity can be generated in the operations of grinding, sifting, blowing, extracting and pouring. All equipment used for these operations and the containers in which the dust or powder is collected should be bonded together and earthed.

In some processes collecting brushes may be fitted, or the surrounding atmosphere made conducting by the use of ionising radioactive materials or by increasing the humidity. Conducting rubber should be used in vehicle tyres and footwear employed where static discharges would be dangerous.

Fire at a chemical works in Middlesbrough

Static does not appear in the list of more common sources of ignition given in Table 1, as relatively few fires are attributed to it. Such is the nature of this phenomenon, however, and so widespread its occurrence that it may well be responsible for many of the fires described as of ' unknown source.'

Unavoidable sources of ignition

So far the sources of ignition discussed have been far from indispensable. Those sources which are essential to the function of the factory must now be considered.

Many reactions by which chemicals are manufactured require a supply of heat; other reactions generate their own. Processes such as distillation, solvent extraction and drying require heaters, while construction, maintenance and repair operations include many hot processes such as welding, cutting, soldering and riveting.

Table I. Causes of Fires in Industry

Sources of ignition	*% of fires caused*	
	Chemical industry	*Other manufacturing industries*
Unknown ..	22.7	14.9
Misc. undefined..	9.3	7.6
Misc. electrical equipment	6.6	4.6
Mechanical heat and sparks ..	6.3	9.4
Gas burners ..	6.2	2.7
Smoking materials	6.2	10.1
Misc. gas equipment	5.8	3.1
Oxyacetylene burners	5.6	3.9
Electric wire, cable other than leads to apparatus ..	5.0	3.9
Spontaneous combustion ..	3.6	1.3
Misc. oil-burning equipment ..	3.1	1.6
Other specified causes	19.6	34.9

Heating plant

With regard to processes requiring an external supply of heat, the high incidence of fires caused by specialised heating equipment has already been mentioned and there would appear to be a case for the more careful design of this plant from the fire protection viewpoint. In his report for 1954 the Chief Inspector of Factories had this to say of gas equipment:

' Let all builders of gas equipment now offer their customers the option of buying safety as well as efficiency, and let all users of gas refuse to buy equipment that is not as safe as it can practically be made . . . .'

These remarks apply equally well to electric and oil-burning plant.

Where open-flame heating is necessary, automatic protection should be provided against ignition failure or flame failure.

All heating plant should be thermostatically controlled at a safe temperature.

Space heating should be by steam, hot water or hot air, and the heat-generating plant should be outside the compartment. This is particularly important if there are flammable gases, vapours or dusts present. Additional precautions are still necessary to see that hot pipes do not ignite woodwork or other combustible materials. The temperature of woodwork should not be allowed to exceed 150°F. The misuse of space heating, as

for example for drying clothes, should be prohibited. The same precautions should be taken with drying ovens.

Fire hazards of electricity

Flammable liquids, even in small amounts, can be ignited by electric equipment. Few people realise how easy it is to start a fire when handling petrol, naphtha, white spirit, turpentine, degreasers, paint thinners and the like. Great care should be taken in handling these liquids and no process capable of producing a flammable concentration of gas or vapour should be carried on unless the equipment in the area is flameproof (bearing the registered flameproof mark in accordance with British Standard 229: 1946, 'Flameproof Enclosure of Electrical Apparatus') or otherwise suitably protected. It is not enough to dispense with exposed heating elements, since all electric equipment other than that designed specially for flammable atmospheres can provide the means of ignition.

Changes of layout, process or occupancy may give rise to unsuspected dangers. Lights, heaters, motors, switchgear, cables, portable equipment or any other equipment which originally may have been correctly and safely installed may become dangerous if changes take place in their use or surroundings. Changes may expose the equipment to accumulations of combustible material, conditions of excessive heat or restricted ventilation, or to flammable atmospheres of dust or vapour where none existed before; they may also lead to overloading. A careful check is necessary before and after any alteration is made, even a temporary one, to ensure that no hazard is introduced.

Where conditions permit, transformers and, as far as possible, other oil-filled apparatus should be situated in separate fire-resisting compartments. Such apparatus should if possible be installed over ballast-filled sumps of sufficient size to receive and extinguish any burning oil which may be liberated. As an alternative to sumps, sills should be provided around the apparatus, or at least at the doorways, to restrict the flow of oil. Where space permits, large oil-filled transformers should be situated in the open over ballast-filled sumps or surrounded by curbs of sufficient height to contain escaping oil.

Conclusion

It cannot be too strongly emphasised that an article such as the foregoing can only outline some of the fire hazards that must be considered by chemical engineers and should not be regarded as a substitute for the proper study of the relevant acts and regulations. This study should be supported by expert advice and information, of which there are numerous sources such as the factory inspector, the local authority fire brigades, the insurance companies, the Joint Fire Research Organisation, the Association of British Chemical Manufacturers and the Fire Protection Association. The latter Association has published numerous booklets and technical information sheets dealing with the various fire hazards that have been touched on in this article and they are obtainable on application to the Association at 15 Queen Street, London, E.C.4.

Thanks are due to the Fire Protection Association for supplying the photographs illustrating this article.

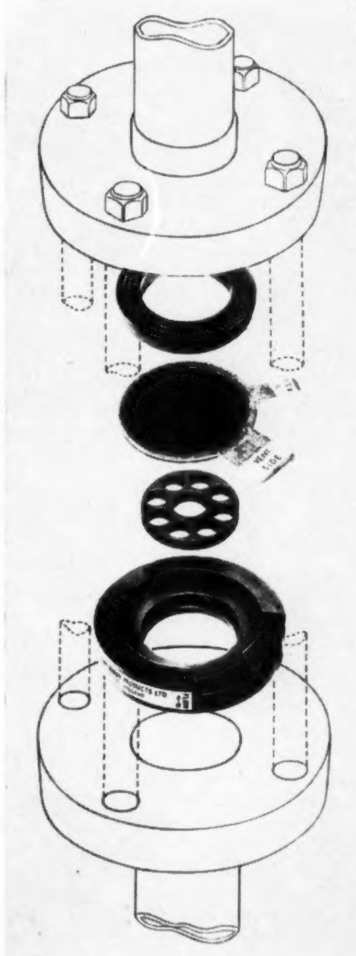
Bursting Discs in Carbon and Graphite

Bursting discs are being increasingly employed as a means of protecting pressure vessels or other plant from over-pressure through the medium of a diaphragm of material weaker than the vessel structure itself. Designs in current use employ various metallic materials, but Powell Duffryn Carbon Products have now introduced to the United Kingdom a range of bursting disc assemblies in carbon and graphite. These are claimed to be completely resistant to the corrosive effects of a very wide range of contact materials and it is stated that temperatures up to 160°C. can be tolerated without deterioration of the physical properties of the disc or reduction bursting accuracy.

The assemblies are of simple design, comprising a two-part carbon holder and a replaceable graphite disc. The design of the holder and disc is such that replacement discs are easy to install and, moreover, location of the disc in the holder is 'fool-proofed' by means of the special slotted holder arrangement. The assembly clamps between pipework flanges adjacent to the installation to be protected.

The standard range is available in sizes of 2-in., 3-in., 4-in. and 6-in. bore. Pressures between 5 and 75 p.s.i.g. are offered and bursting accuracy is guaranteed within ±5% of the rated burst pressure.

For discs rated 20 p.s.i.g. or below, vacuum supports of either bar or dial type are available if the possibility of vacuum conditions within the vessel exists. Working pressures may be up to 75% of the nominal burst rating. Special ratings are also available and the Hayes factory has recently produced for the U.S. market 6-in. discs rated at 1 p.s.i.g. vacuum for the protection of lead lining in process vessels under conditions of negative pressure.



Exploded view of the 'Delanium' graphite bursting disc assembly introduced by Powell Duffryn Carbon Products Ltd. Replacement discs are available with gaskets affixed to both faces and tab indicators showing the vent side and the burst pressure rating of the disc.

Modern Trends in Extinguishing Chemical Fires

IN considering fire-extinguishing equipment in the chemical industry it is difficult to distinguish modern trends from adaptations of old, well-tried methods. Fire brigades have available for fire fighting only two materials in appreciable quantities, namely water and foam, but considerable advance has been made in the use of both. Over the past few years there have been changes in the fixed installation and portable equipment fields, but with a few exceptions these have been in design improvements rather than anything more revolutionary in the way of using completely new extinguishing agents and methods.

A remarkable feature of the work of the fire brigades in Britain is the close liaison that has been established, notably since the war, between the brigades and industrial managements. As regards techniques, water is still the basic fire-extinguishing agent for dealing with large fires, as normally it is the only agent which is available in sufficient quantity. Increasing use is being made of spray and fog equipment. For flammable liquid fires, brigades carry foam compound and foam-making equipment and they now have a system whereby they can call upon stocks of compound from all over the country if necessary. Much improved foams are now available, including some intended for use on flammable liquids which are miscible with water, as these liquids tend to break down ordinary foams rapidly.

Fixed installations

A fixed fire-fighting installation has the purpose of speedy attack on a fire with what is considered to be the most suitable extinguishing agent for the material involved. Since the sooner an agent is applied to a fire the more certain it is to be effective, there has been a pronounced trend to automatic operation of equipment.

Water sprays. Probably the most familiar water-spray system is the automatic sprinkler installation. Sprinklers are generally recognised as the most suitable automatic extinguishing systems for the general protection of buildings.

Drencher systems are similar in many respects to ordinary sprinkler systems. They are used to prevent the spread of fire to the plant or building protected by them. They are widely used for protecting plant containing flammable liquids.

For controlling and extinguishing fires in particular risks, notably flammable liquid risks, special spray systems have been developed. These require higher pressures than the ordinary sprinklers and drenchers and the outlets are designed to produce either very fine sprays or high-velocity coarse sprays.

Foam. Self-contained installations are available which can be arranged to work automatically. A type which has come out in recent years is one which generates the foam by air or gas from a cylinder. It has the advantages of having less bulk than some other systems and of not requiring a mechanical generator.

Increasing use is being made of base injection of the foam to supplement and sometimes replace systems which apply the foam on the surface of the liquid.

Gas and vapour extinguishing agents. These include systems using carbon dioxide, nitrogen, carbon tetrachloride, methyl bromide, chlorobromomethane and steam. Carbon dioxide is the most common. Volume for volume and weight for weight, CO_2 is not as efficient as CTC, MB and CB, but it has the important advantage that it is non-toxic. The systems are arranged either to flood completely the protected space or to provide local application to particular points.

Dry powder systems. These installations have been introduced in Britain recently. It seems that their chief value is likely to be for flammable liquid risks.

Explosion suppression. A system has been adapted for suppressing explosions in dusts and vapours from an arrangement developed to protect fuel tanks of military aircraft during the war (see CHEMICAL & PROCESS ENGINEERING, 1955, **36** (9), 319). There are now numerous installations, protecting such plant as grinders, pulverisers, dust extraction systems and conveyors. The system is designed to detect an explosion in its incipient stages and to suppress it automatically before dangerous pressures are reached. Other means of limiting explosion damage such as drop flaps, explosion vents and inerting compartments in advance of the explosion can be arranged to be actuated simultaneously. Suppression is achieved by the release of a gas at high pressure.

Portable extinguishers

For fires involving ordinary combustible materials, various types of portable equipment are available making use of water as the main extinguishing agent. For small fires in flammable liquids the most suitable forms of extinguishing agent are foam, vaporising liquids, carbon dioxide, dry powder and sand.

There are two types of foam extinguisher—chemical and mechanical—both types being similar in construction and capacity to the water-type (soda/acid) and water-type (gas pressure) extinguishers. Foam, like water, has the disadvantage of being a conductor of electricity, apart from the fact that most types of foam are unsatisfactory for use on flammable liquids readily miscible with water. In addition, foam extinguishers are adversely affected by low temperatures.

In carbon tetrachloride, methyl bromide and chlorobromomethane extinguishers the extinguishing agent is expelled in the form of a jet or spray. These liquids are all non-conductors of electricity, but there are other factors to be taken into consideration, depending on the circumstances. None of these agents is to be recommended for use where there is any risk of its vapours and those of the decomposition products being inhaled, as they are toxic.

Dry powder extinguishers have recently come into prominence as a means of extinguishing small fires in flammable liquids, electrical equipment, chemicals and other substances for which other extinguishing agents would be unsuitable. Generally the powders and the expellants are not completely chemically inert and there may be a possibility of reaction where some materials are involved.

A further means of extinguishing fires is provided by hydraulic hose reels, which may be used to supplement, or instead of, extinguishers and buckets.

A free advisory service on methods of extinguishing fires is operated by the Fire Protection Association, which includes amongst its literature booklets on 'Portable Fire Extinguishing Appliances,' 'A Comparison of the Extinguishing Effects of Chlorobromomethane, Methyl Iodide and Carbon Tetrachloride' and a leaflet on 'Dry Powder Extinguishers.'

FILTRATION

By H. K. Suttle, A.M.I.Chem.E., F.R.I.C., M.Inst.F.
(Department of Chemical Engineering, Loughborough College of Technology)

Theoretical and practical advances; filter aids; filter media; filtration in air pollution control; chemical processes

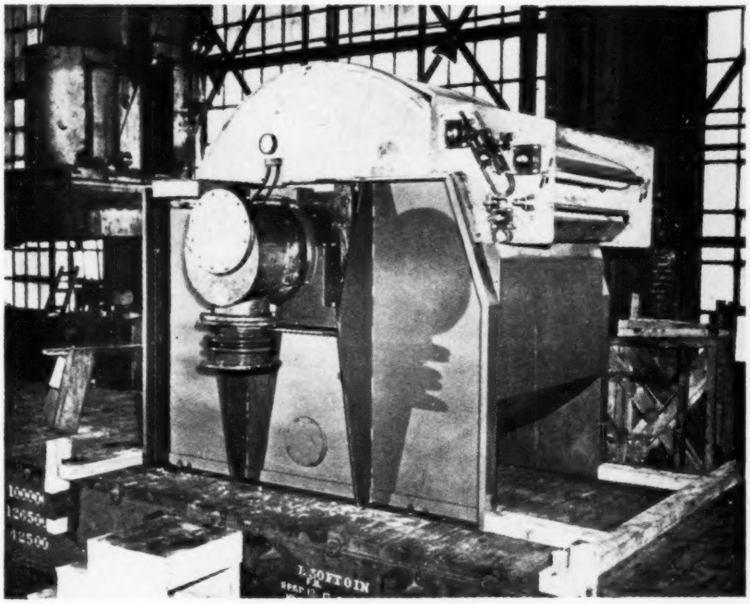
THERE are few instances in the process industries where the separation of solids is not an operation of considerable importance. The comparatively short period covered by this review has yielded abundant evidence of sustained interest in filtration processes, especially the properties of the filtering medium and the problems associated with the cleaning of air and gases.

Three works which would appear to be essential to the technologist have appeared, of which two are concerned with normal filtration processing. A text concerned with general questions of scaling up[1] contains a chapter devoted to the scaling up of filters, in which the authors observe that at the time of preparing this text they could not recommend a method for the scaling up of a continuous filtration process, although careful consideration is given to methods for filter presses and similar units. The British Standards Institution has published a method for testing air filters[2] in which filtration efficiency is measured gravimetrically by the use of alumina dust and also by the staining effect obtained with dust clouds of methylene blue. The apparatus employed and the test procedures are given. Although the work contains no direct reference to filtration, as normally understood, attention should be devoted to Volume 3 of the series edited by Cremer and Davies[3] which contains excellent sections on both gas treatment cyclones and the technique and processes of electro-precipitation.

The comprehensive review by Prof. Miller[4] contains 184 references and must prove valuable to investigators in this subject.

Fundamentals

Prof. Heertzes, of the Technische Hogeschool, Delft, has continued his studies on fundamental phenomena.[5, 6] The filtration process is conceived as being a gradual change process during which the filter medium becomes partially blocked and, after a particular concentration is reached, cake filtration is the true, controlling, process. The conclusion is that a further type may exist which can be termed blocking-filtration of the cake. Following this, it is shown that the specific resistance of thin filter cakes is markedly influenced by the initial rate of filtration, as well as by the concentration of the slurry. In general, the specific resistance is lowered when the rate and the slurry concentration are increased. The author presents an equation relating rate and concentration for conditions where the initial filtration rate is constant.



The photograph shows one of the latest 'Rotobelt' filters as it was being shipped from the factory of the Eimco Corporation (U.S.A). The take-off and return rolls should be noted, together with the stainless-steel belt. The drum section is 8 ft. in diameter by 4 ft. face, high submergence, and is installed for the filtration of hot, black liquor containing much fibrous material. The filtered liquor then passes to evaporators. A further difficulty encountered at this stage in wood processing is the presence of a pitch, or resin, which tends to blind the filter medium on a conventional drum filter, but which has been successfully dealt with by a spray system on the 'Rotobelt' filter. The amazingly high rate of 5 gal./min./sq.ft. is achieved with this unit at this works. The vacuum system is constructed on the barometric leg principle. The research department of the Eimco Corporation has developed continuous pressure filtration to the point where highly reactive solids and liquids may be treated in hydrogen atmospheres at 350°F., or even higher, under pressure.

A similar fundamental approach has been published by Hutto,[7] using experimental apparatus inspired by the work of Carman[8] and incorporating refinements suggested by Grace.[9] The distribution of porosity in the cake was investigated by the use of a filter cell, constructed of *Lucite*, in the form of a cylinder. The unit was sealed with O-ring seals to the end pieces and was provided with a porous, stainless-steel, bottom plate. The range of pressures possible was up to 100 p.s.i. Careful thought has been given to complete instrumentation of the test set-up in order to eliminate probable errors of observation. The method adopted was to form the filter cake in a series of layers, the various bands of which were photographically recorded during the course of the filtration. The conclusion reached is that, generally, the porosity decreases quite rapidly near the surface of the cake in contact with the liquid, but this rate is lowered further in the cake and continues at a slower, almost linear rate of decrease, until the minimum porosity is reached at the filter septum.

The relation between engineering science, test procedures and design is a challenge, and a reason for the virility of chemical engineering. If simple experimental observations can provide adequate data these may be all that is required. This is the basis of a paper by Hassett[10] in which the normal theoretical treatment is presented in a rationalised form. The discussion is convincing and two examples are given to demonstrate the accuracy of the method, which involves filtration constants in a much simplified form.

Practical advances

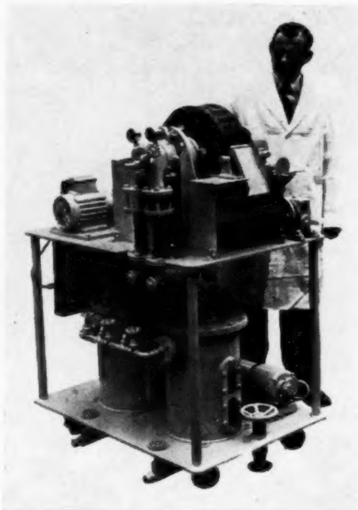
Two most useful articles have been presented by Purchas[11, 12] on selecting the size of rotary vacuum filter equipment. Part 1 is concerned with experimental details of a test procedure, using a simple filter leaf, and a detailed description of the operation of a rotary filter. In Part 2 the interpretation of experimental test results is considered. From the information so obtained, it is suggested that the operation of a rotary filter may be expressed by the equation:

$$W = 0.001057 \frac{GB}{t_f A} \text{ dry lb./(sq.ft.) (hr.)}$$

where G = weight of cake formed, convenient for the process, expressed as g., dry; t_f = form time, min.; A = filter leaf area, sq. ft.; and B = effective submergence, % of area.

On page 212 of reference 12, Purchas provides a nomogram for the solution of this equation for various types of rotary filters.

Probably the first serious attempt to predict the scale-up of continuous filtration equipment, and filtration data for such units, is contained in the paper by Dahlstrom and Purchas[13] at the symposium organised by the Institution of Chemical Engineers. Four distinct rate processes are visualised, namely: (1) cake formation, (2) cake dewatering, (3) cake washing and (4) the rate of thermal drying. Within each division the theoretical aspects are discussed together with actual plant data. For example, in (1) evidence is presented of the significance of the time allowed for cake formation, the concentration of the slurry and working pressure drop, all of which influence the value of the specific cake resistance. In (2) there are 13 major factors which are said to influence the process, whilst section (3) includes a typical calculation. The final division (4) of this paper contains a full discussion of the problem and also an example calculation.



This 'packaged' filter, designed to be fully self-contained, compact and easily transportable, has an effective filtering area of 1 sq. ft. The interconnecting pipework on the unit is so arranged as to make it possible to use the receiver tanks in parallel or in series according to the duration of the run. Makers: Davey, Paxman & Co. Ltd.

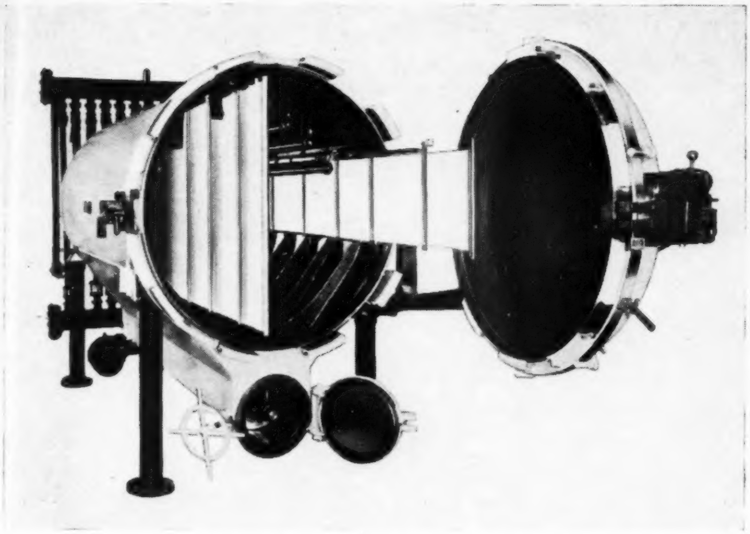
At the National Meeting of the American Institute of Chemical Engineers, June 1957, several papers on filtration were presented. Reference 14 contains the list of those which have not been available for review, although brief outlines of the papers have been published. Tiller and Cooper present contribution No. 4, from the University of Houston, on the part played by porosity, whereas W. Leppla *et al.* describe the uses of a new pre-coat filter test leaf. The writer is indebted to Prof. Dahlstrom for a copy of the paper presented by himself and P. A. Nelson at this meeting,[15] which is concerned with the moisture content of the cake from a rotary vacuum filter. An experimental programme was initiated for this purpose. The theoretical approach is a slight variation from the work of Brownell *et al.*[16] This is used to evolve an expression which can be used to correlate the experimental work, provided that (*a*) the filter cake is incompressible, (*b*) the filter cloth resistance is negligible and (*c*) the specific permeability of the cake is uniform and unchanging. It appears that for practical purposes this method is satisfactory, and also enables the prediction of the economical filter area and the conditions of operation.

Where difficultly filterable slurries are encountered, and it is undesirable to undertake expensive conditioning treatment, the very flexible drum filter is first choice. In such cases, however, thin cakes may result with the attendant possibility of damage by the scraper blade. In order to overcome this fault, as well as cloth blinding and filtrate blow-back, the so-called *Roto-belt* filter has been devised. Cornell, Emmett and Dahlstrom have described this new unit[17] which is adapted for use on a drum similar to that in common use. It consists of an endless belt of filter cloth which passes over a small drum-discharge roll at which point the cake is conducted away by means of the scraper blade. The filtration process is conducted at the large drum, but the cake is removed with much greater certainty at the small-diameter roll.

In contrast, a vacuum air-lift has been used for the removal of air and filtrate from a continuous filter, according to a Japanese report.[18]

Filter aids

Nevertheless, filter aids must be used in many cases, and for this purpose diatomaceous materials are commonly used. An advertising feature[19] describes a carbon-based filter aid which is said to be useful for caustics or fluorides. The sugar industry uses these materials widely and useful observations are to be found in an article by Balch[20] in this regard. The author is concerned with a labora-



'RSC' filters are specially designed for use with materials that are either toxic, inflammable or generally which are dangerous to human beings. The plates of the 'RSC' filter are individually connected and valved so that any plate may be removed from filtration duty merely by shutting the outlet valve for that particular plate. This filter has been found very useful in the processing of insecticides, pharmaceuticals and chemicals where the primary object is removal of moderate amounts of solids from a process liquor. The amount of wash water used to clean off the cake after a filtering cycle depends naturally on the particular material being filtered. The filter is equipped with screw conveyor which can be used in a completely closed system and it never becomes necessary to open the filter or its associated piping for the purpose of recovering the solids or handling the filtrate. For example, the wet solids coming from the screw conveyor can be transferred either by gravity or by slurry pump to another process station whether it be a washing station or a chemical reaction vessel, or even to another filter. The photograph illustrates the special design of quick-opening cover, and the filters can be made in either mild steel or stainless steel and are also suitable for steam jacketting if required. The new 'RSC' filter has been developed by Sparkler Manufacturing Co. in America and is being manufactured in Holland by Sparkler International Ltd. The U.K. selling distributors are L. A. Mitchell Ltd.

tory test designed to assist in characterising the filterability of sugar solutions (50 to 60% sugar). The experiment consists in determining the time required for 500 ml. filtrate to percolate through 1 sq. in. of cotton twill cloth at 85°C. and 20 p.s.i., when a diatomaceous silica filter aid (about 1% suspension) is used. The author remarks on the discovery during the course of this study that dissolved salts significantly affect the filtering characteristics of the filter aid. This observation must be important for those in other fields who use this type of filter aid.

Whatever may be the reason, the characteristics of porous materials of this nature must be of interest and the reader is directed to an interesting paper by Maatman and Prater[21] which is concerned with the distribution of the activator on the internal surfaces of porous catalytic supports, impregnated by means of solutions. The capillary forces drawing the liquid into the pores are very large, being of the order of several hundreds to thousands of atmospheres pressure, for pores which have diameters characteristic of the usual catalyst bases. For a cylindrical capillary, the capillary pressure is given by the quantity $2\sigma/r$, where r is the capillary radius and σ is the surface tension, whilst the average radius is given by $r_{av.} = 2(PV)/(SA)$, in which (PV) is the pore volume and (SA) is the surface area. The driving force is surface tension and the opposing force is viscous flow. These are equated to give the penetration time (t) by the expression:

$$t = \frac{2\eta}{\sigma} \frac{x^2}{r}$$

in which η is the coefficient of viscosity and x is the distance penetrated in time t. The authors note that the effective capillary length x is larger than a straight tube by a tortuosity factor of about $\sqrt{2}$. They also point out that, since the driving force is so much greater than 1 atm., evacuation of the gases in the solid has little effect on penetration time. Two examples have been selected to illustrate these phenomena and are given in Table 1.

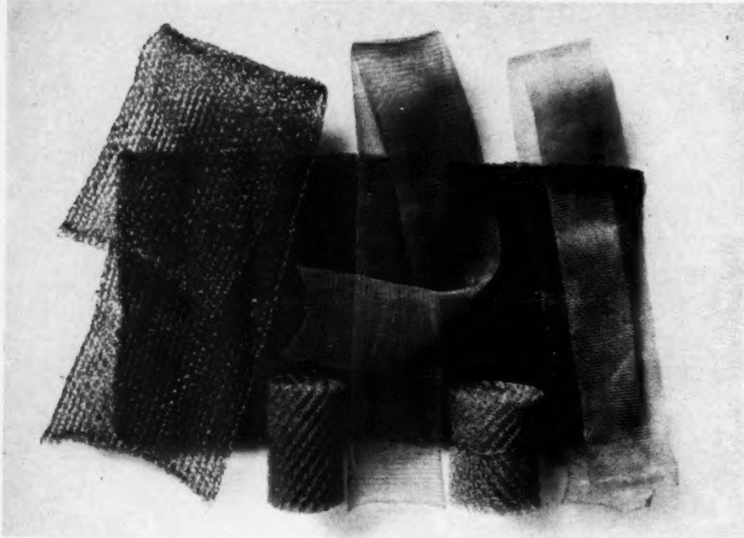
Despite such aids to processing, the question arises whether a greater output can be obtained from a conventional-type rotary filter. G. Vernois[22] asserts that the non-cellular rotary filter does meet with these requirements, for some 95% of the drum surface is utilised for filtration purposes (immersion 40 to 55% of the surface), there are no dead spaces to evacuate and it is mechanically simple. A clear outline of the design is given and a flowsheet is shown, consisting of a layout for the treatment of carbonated sugar juice. A horizontal tank filter, for sugar filtration, has been described as a unit with self-cleaning filter plates (internal jet sprays) with individual valves on each leaf.[23] An editorial article describes some of the exhibits shown at the 4th Salon de la Chimie, Caoutchouc, Matières Plastiques, in Paris.[24] The filtration techniques used for varnishes is described in a general article, with illustrations.[25]

The treatment, by a conditioning process, of industrial waters and wastes before the filtration process has been the subject of several papers and articles. G. Bosenick[26] suggests that suitable chemical and physical treatment will render slurries, which are difficult to de-water, capable of being filtered by the usual methods, and gives data for a towns' filter plant. Zdansky[27] suggests that colloidal precipitation can be brought about by the use of cast-iron chips, and may be applied to river water. The removal of colour from industrial process wastes may be brought about by coagulation and settling, followed by filtration, according to Nordell.[28] This article contains a section dealing with colour measurement.

In Germany, the composition of the

Table 1. Examples of Pressures and Penetration Times in Support Particles (Maatman and Prater[21]).

	Surface area	*Capillary pressure*	*Time to penetrate 2 mm. sec.*	
	Sq. m/g.	*Atm.*	*Calculated*	*Observed*
Silica gel	650	1,300	210	—
SiO_2-Al_2O_3 beads ..	350	640	105	95 ± 20



Examples of modern 'fabrics' available to the filtration engineer. The material is manufactured (by Knit Mesh Ltd.) in the form of knitted stocking mesh from a wide variety of 'fibres' (glass, synthetics and metals) and then arranged as required to form filter mats, demisters, and similar units. The special knitted mesh construction ensures a product which is strong and resilient, forms good gasket joints, has a large surface area together with as much as 95% free space, and is generally easily cleaned.

water from the various sources which feed the Ecker reservoir is very variable. The drainage area contains a swampy region and the presence of humic acids, especially, makes filtration difficult. Ordinary materials, such as bentonite or selected clays, made filtration even more difficult. When, however, a 1% solution of yellow dextrin was used the filtration rate was doubled.[29] The formation of flocs by the addition of agents similar in nature to dextrin to aid the filtration process has long been known, as for example starch solutions for coal slurries and glue for alum. Hudson[30] outlines the mechanism of floc formation in a very informative article, which is supported with 19 references. The behaviour on filtration is suggested as one of the means for measuring the effectiveness of flocculation.

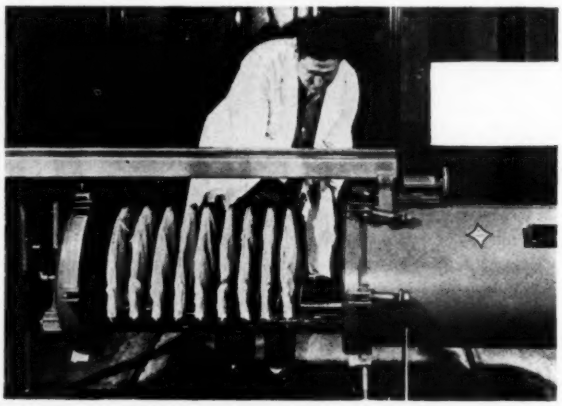
A new flocculant is a high-molecular-weight polyacrylamide manufactured by the Dow Chemical Co. and known as *Separan* 2610.[31] The addition of 0.2 lb./ton doubled the filtration rate of a uranium-containing solution. In the case of a coal slurry, where 5 to 7 lb. starch per ton was required, only 0.02 to 0.05 lb./ton performed the same duty.

All-round improvement in filtration and cake properties usually results from careful attention to the flocculation process, especially where large amounts are treated on rotary filters. This is particularly well illustrated in a paper by Dahlstrom and Cornell[32] which is divided into three distinct sections. The first section consists of a lengthy introductory account in which the main problems are reviewed and special emphasis is laid on conditioning of waste effluent before filtration. The leaf test technique for filtration characteristics is useful at this stage.[33] The next division deals with the fluid mechanics necessary in the design of conditioning equipment[34] together with the experimental procedure adopted. The third section is a short treatise on continuous vacuum filtration together with comparative working data on a normal drum filter and the new *Rotobelt* drum filter. The evidence shows that the *Rotobelt* unit may be expected to give not only a substantial increase in production but also a reduction in cake moisture.

Modern high-pressure boilers require water of extreme purity (silica being of the order of 2 to 3 p.p.m. in the concentrated boiler water) and, in order to achieve this, demineralisation processes are adopted. The water is filtered in several anthracite pressure filters before it is treated at the zeolite units. Such processes have been admirably described by S. B. Applebaum *et al.*[35, 36]

Filter media

There is continued interest in the properties and performance of filter media. In a paper dealing with non-woven filter media, A. C. Wrotnowski[37] discusses three types of fabrics, namely, mechanically interlocked fibres, wool felts and bonded fabrics of synthetic fibres. The qualities desirable in a filter cloth are discussed very fully and practical charts are given to assist in the choice of suitable material. One of these charts presents liquid permeability *v.* air permeability with parameters of viscosity. It was found necessary to limit the data to non-



Among the newer fibres in industrial use for filtration processes is 'Dynel' which is stated to be very strong and to have a high resistance to abrasion, and to lose little of this property even after prolonged wetting. It is also claimed to have excellent resistance to alkalis. The illustration shows 'Dynel' bags containing a filtering medium being placed in position on the leaves of filtration equipment for caustic mercerising solutions. 'Dynel' is an acrylic fibre manufactured by the Union Carbide Corp., U.S.A.

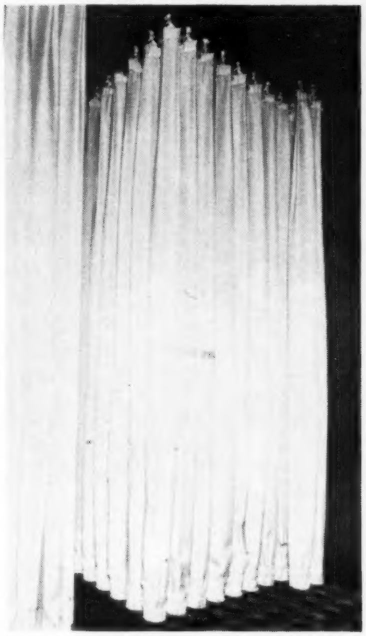
aqueous liquids, as it was found that plugging action occurred with aqueous solutions and even with distilled water. It is assumed that this phenomenon is similar to that found in ion-exchange beds where it is known that dissolved gases are released and impair the flow through the bed. The plugging action occurs on wool, cellulose, and even on hydrophobic synthetic fibres. The phenomena of particle leakage from the cloth (' bleeding '), blinding of the cloth and gasket action are discussed.

Zievers, Crain and Werchun[38] have presented an interesting paper concerned with a commercial test method for the determination of the retention of fine particles by a filter medium, in particular papers, felts, and non-woven fabrics. The apparatus employed is simply a vertical tube with a removable orifice at the base and into which is fitted the filter medium. After addition of the solid, the time is taken for the efflux of a 12-in. column of water, leaving a 12-in. column remaining on the sample. Comparison with the results of other workers shows good correlation and a nomograph is given for the interpretation of test results.

An article[39] is devoted to explaining how the use of synthetics has extended the range of use of felts. The development of *Feutron* felts is described, consisting of 100% synthetic fibres interlocked mechanically without a binder. They are reported to be the first truly non-woven synthetic fabrics consisting of fibres only. The material is made in widths up to 80 in. and thicknesses from 0.015 to 1.00 in. The weight varies from 2 oz. to 6 lb./sq.yd. It has aroused interest in fields other than that of filtration; for example, a new gasket material, *Vistex*, is a polyester fibre impregnated with *Teflon*. Polyvinyl chloride is the base material for French fabrics now made in U.S.A.,[40] for use in industrial filtration. This material has notable properties which may be listed as follows: (*a*) it does not swell in water; (*b*) the tensile strength and elasticity are not affected by water or most aqueous solutions; (*c*) stability to atmospheric and biological conditions; (*d*) not affected by concentrated acids, concentrated alkalis, detergents, oxidants, aliphatic hydrocarbons and alcohols; (*e*) abrasion resistance exceeded only by nylon and *Dacron*; (*f*) can be unplugged by washing with reagents. Removal of dust or dust particles from air is facilitated by electrostatic charges which build up on the fabric and hold the particle.

Air and gas filtration

The ever-present problem of atmospheric pollution has attracted the attention of many investigators. In a paper concerned with the use of fibrous filters for the sterilisation of air, Gaden and Humphrey[41] remarked that filtration through beds of fibres is still the most common method, although granular solids (carbons) and specially prepared filter media are in use. Design is ' still judicious guesswork tempered with experience.' The principles of the design of air filters are discussed and an example is given. There are 19 references. This paper is followed by an interesting account presented by Maxon and Gaden[42] in which it is demonstrated that pilot-plant studies have shown good correlation with laboratory data.



This photograph illustrates the use of a fabric woven of ' Fiberglas ' in two Tilghman special dust arresters that have been installed at the carbon black plant of Philblack Ltd. at Avonmouth. The presence of gases which can give rise to corrosion made it most desirable to maintain the temperature of the collectors well above the dewpoint (around 160°F.) and this ruled out the use of normal fabrics. The special glass fabric is the result of research carried out by Tilghman's Ltd. and their American associates, the Wheelabrator Corp. In the Avonmouth installation, the dust collectors are fitted with special inlet ducts to discharge the dust-laden gases in a downward direction into the hoppers, to reduce considerably the dust loading of the gases presented to the fabric filter tubes. The gas is then drawn vertically through the openings in the cast-iron tube plates and thence into the open end of the fabric tubes. Having deposited its dust burden on the interior of the tubes, the gas passes to a plenum chamber, being drawn by an exhaust fan for discharge to the stack and thence to atmosphere. There is provision for the mechanical shaking of the tubes should excess conditions occur which result in a very large overload of black being submitted to the tubes. The dust collectors form part of recent plant extensions and development at the Philblack works, E. B. Badger & Sons Ltd. being the main contractors.

Hammond[43] has described the techniques used for cleaning air and gases in the chemical industry. This includes filters and a description is given of one of British manufacture. The 50th anniversary meeting of the Air Pollution Control Association of America was held during the past year. At this gathering, Lunde and Lapple[44] presented a very interesting, general paper on the present state of knowledge of the subject of dust and mist collection, and they suggest possible future trends. The presentation is very attractive and holds the attention of the reader throughout. A short historical note accompanies the paper and also a useful summary which bears the heading, ' Mechanism and Parameters in Aerosol Deposition.' The difficulties of measurement are emphasised. Although filters are discussed as methods for the recovery of dusts, Leers[45] seems to prefer electrostatic methods. The principal section of this article deals with the physical properties of dusts below about 5μ particle size.

Filter mats of borosilicate glass wool have been used to effectively remove phage particles, according to a paper by Sadoff and Almlof.[46] In submerged culture techniques there is always the potential danger of bacteriophage infections. Full details are given for the preparation of the test organism (a virus of diameter 0.08μ) and, in the experimental work, radioactive phosphorus was used as a tracer. The underlying theory is presented and a design problem is solved. There are 12 references.

The Central Electricity Authority is concerned about the emission of dust, and sulphur dioxide, in the vicinity of power stations. An informative paper has been presented by Jarvis and Austin[47] on this subject. Through routine surveys of the problem, they conclude that the dust content in the flue gases emitted is of the order of 0.05 gr./cu.ft., despite the use of highly efficient plant. Lucas[48] has presented an interesting paper dealing with the nature of deposition of dust. Experiments conducted

in order to survey deposition in the region of an electric power station led to the conclusion that only one quarter of the dust collected in the deposit gauges originated from the power station. It was shown that, if wind speed exceeds about 20 ft./sec., re-entrainment of deposited dust is likely to occur. The discussion to the papers concerned with this and other topics has just been published.[49] An article by C. A. Bishop[50] deals with air pollution and its control. The 11 principles agreed by the E.J.C. Air Pollution Committee in September 1957 includes one which states: ' It is the responsibility of the engineering profession to participate vigorously in the field of air pollution control.' There will, doubtless, be general agreement with this statement, particularly amongst filtration technologists. Methods of treatment are suggested and classified, and it is stated that in most circumstances air pollution is amenable to control. Many investigators would doubt such a sweeping statement, even when considered in conjunction with the further qualifying remarks, but all will agree with the further statement that ' the engineering profession is prepared to discharge its responsibilities . . . by full participation with other professional disciplines in establishing and effecting sound policies of control.'

Filtration in chemical processes

Radioactive assay processes require special techniques for filtration. An article[51] describes such an apparatus evolved at the Rockefeller Institute for Medical Research, and an official publication by Atomic Energy of Canada Ltd.[52] describes a system of filtration used for radioactive precipitates, using molecular filter membranes.

The broad activities of the chemical industry involve the use of filtration processes on an ever-increasing scale. In a paper by Johnson *et al.*[53] a process is discussed for the recovery of uranium from slag scrap. The slag concerned is the discarded MgF_2, containing entrapped uranium, and resulting from the exothermic reaction of uranium tetrafluoride and magnesium. Subsequent treatment involves digestion with HCl and $NaClO_3$ and this is followed by filtration of appropriate sizes on a pan filter and on a pre-coated rotary vacuum filter. The filtrates are returned for recovery of uranium as uranyl ammonium phosphate, which is finally converted to sodium diuranate. The flowsheet given shows five filtration operations. An informative article by Sawyer[54] is concerned with the production of boron chemicals from Searles Lake brines. The crude borax slurry is first dewatered in two horizontal, 13-ft., flat-bed filters, and final dewatering is accomplished in centrifuges.

Legal *et al.*[55] have discussed the manufacture of phosphoric acid from phosphate rock by a clinker process. This is essentially the decomposition of fluorapatite with concentrated sulphuric acid heated to 100°C. During the reaction and subsequent clinkering of the mass, fluorine compounds are evolved to such effect that the fluorine evolution is almost 90% complete. The dried product is leached in either a counter-current leaching system (five-stage) or in a filter system (eight-stage). The waste is calcium sulphate. In such a process constructional materials must be carefully chosen, and the recommendations are lead and 316 stainless-steel filter cloth. *Teflon*-punched cloth is excellent but very expensive.

The use of continuous filters in uranium ore processing is the subject of a further paper by Dahlstrom and associates.[56] A. Gruenstein[57] describes a simple, but very effective, method for filtering milk of lime which is being recirculated through an ejector. Filtering was necessary as the ejector jet was only 7 mm. diam. The ejector thus operated by the circulating liquor creates the vacuum necessary to draw in waste chlorine and so form calcium hypochlorite. The filter is made up from PVC sheet perforated with 0.1-in. holes. In a paper by Hull and Stent,[58] on the processing of gold, reference is made to the use of a 30-frame filter press for the removal of gold residues from a sulphuric acid solution (the acid having been added to dissolve out zinc). Seven continuous rotary filters (14-ft. diam. × 16 ft. long) are used for removing slimes from gold-bearing cyanide solution. The drums are of steel, and heavy canvas faced with wooden grids is the medium. The life of the canvas is 180 days and it is washed daily with a 2.5% solution of hydrochloric acid.

The filtration-extraction of cottonseed oil from the meal, using hexane as the solvent, is described by Haines, Perry and Gastrock.[59] The solids content is 30 to 35% and the filtrate contains, initially, some 9 to 12% oil. In the extraction process, the screen of the horizontal rotary vacuum unit (10-ft. diam.) is 60 × 60 mesh, square weave, stainless steel and operation is at reduced pressures up to 10-in. mercury. Cottonseed processing is considered a highly competitive industry and a cost analysis of the filtration-extraction process is given by Decossas, Many and McMillan.[60]

In an article on processing biochemicals, by E. Gaden,[61] there is to be found a most informative contribution to an understanding of the new ' engineering.' Filtration of the slimy products is difficult—' adequate pretreatment and generous use of filter aids ' may give rates as high as 10 to 20 gal./hr./sq.ft. However, the penicillin process produces a cell material which is fibrous and porous enough to permit of ready filtration with only a light pre-coat of filter aid. Filtration of large broth volumes is a ' messy and costly business.'

At the Baltimore meeting of the American Institute of Chemical Engineers, the important subject of labour costs was discussed.[62] Prutton surveys the relationship of labour costs to total cost of manufacture and, under the heading of ' Capital Savings,' he remarks, ' *Even with standard equipment*—particularly for filtration, sedimentation, and drying—*one must be certain that optimum feed or operating conditions must be known* for most economic design . . . .' (The italics are the writer's.) He goes on to show the broad aspects of equipment selection, location in the plant layout, and design factors.

A further useful paper on this subject was given by F. Gropper. In filtration operations it is perhaps more important than in many others to consider ' human engineering ' or fitting ' the job to the man.' This subject is considered remarkably fully in a paper by B. L. Cusack. This paper concludes with 17 references.

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Electronic level measurement

The technique of using the dielectric properties of either a liquid or granular solid material to measure its level and certain other process variables is now well-established. Continuous level measurement by the capacitance method involves an electronically operated instrument. In terms of instrumentation cost, therefore, it is generally more expensive than mechanical or pneumatic devices. On the other hand, it is usually more economical than level-measuring devices using radioactive isotopes.

Because of this cost factor, its use rests in those applications where, for one reason or another, lower-priced devices are inadequate. Typical examples of capacitance applications are:

(*a*) Continuous level measurement of powdered or granular bulk solids in vessels, *e.g.* grain, cement, and dry chemicals.

(*b*) Cases where the process material is under unusually high or low temperatures, *e.g.* molten sodium or liquefied gases.

(*c*) Cases where the process material is corrosive and hard to handle, *e.g.* liquid chlorine and hydrofluoric acid.

(*d*) Materials under unusually high pressures, *e.g.* polythene and other plastics.

These are in addition to the many applications for which the less expensive devices must be ruled out on the basis of accuracy alone.

The foregoing points are made by Mr. F. W. Hannula, of the Foxboro Co., U.S.A., in the November 1957 issue of *Control Engineering*. He presents the basic principles involved in measuring level by the capacitance method, and concludes that, in evaluating an application, the characteristics of the measured material must be established, its conductivity and its dielectric constant, together with expected variations. Where conducting material is involved, an insulated probe is a must. For non-conducting materials, such as kerosene, gasoline and polythene, a bare probe is suitable. The problem is distinguishing between the two. Generally it is best to consider materials with conductivities greater than 0.1 micromho/c.c. as conductive. On doubtful cases, a covered probe should always be specified.

Continuous acetylene and ethylene production

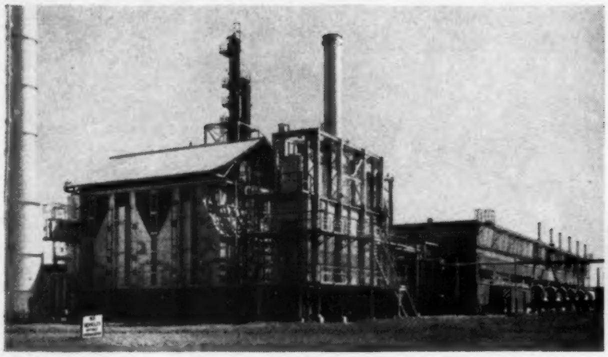
A process for the continuous production of acetylene and ethylene from naphtha or natural gas feedstocks is now offered by the M. W. Kellogg Co., New York, a subsidiary of Pullman Inc. The process, originally developed by Société Belge de l'Azote (S.B.A.), Liège, Belgium, has been further perfected by co-operation between the two companies.

Using naphtha as feedstock, a wide range of ethylene to acetylene ratios may be produced and the flexibility of the process makes possible the simultaneous production of ethylene and acetylene. When natural gas is used as feed, acetylene is the primary product and negligible quantities of heavy impurities are encountered.

The heart of this process is a burner which, it is claimed, is easy to control, requires only minimum attention, is stable and operates continuously to produce a constant yield. Any traces of carbon and residual heavy hydrocarbons are automatically removed by special equipment.

In the process train, the heavy acetylenes and hydrocarbons are separated first, leaving a stream containing acetylene and lighter materials. By using an S.B.A.-developed ammonia absorption system, acetylene is removed from lighter materials comprised essentially of ethylene, hydrogen and carbon monoxide, valuable by-products in themselves. The acetylene, 99.5% pure or higher, is then stripped from the ammonia.

The Eastman process for producing acetylene and ethylene from saturated hydrocarbons, making use of a special furnace, was discussed briefly in our February issue, page 37.



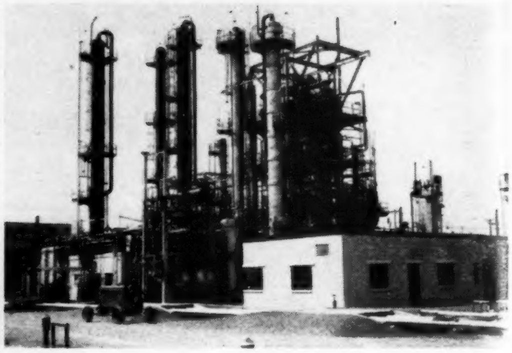


Photo: I.C.I. Ltd. *Photo: The Distillers Co. Ltd.*

Left: A section of the ethylene plant at Canadian Industries Ltd. polythene works near Edmonton, showing the lower part of the ethane cracking furnaces. Right: Phenol distillation section and control room in the plant of B. A. Shawinigan Ltd. at Montreal.

Chemical Engineering in Canada

By C. Arthur Law

With its very great resources of raw materials and its mounting industrial activity, Canada offers immense opportunities for turning chemical engineering techniques to good effect. This article, by a Canadian correspondent, discusses the country's chemical engineering needs against the background of her chemical, petroleum, pulp and paper, metallurgical and other industries, and shows how far these needs have been met, both in the provision of suitably qualified personnel and in the application of modern techniques to industrial operations.

THE chemical engineer in Canada is in the enviable position of being able to choose his life's work in one of many flourishing and up-to-date process industries. Economics alone dictates that the advantages of modern technology be applied so that this nation with a limited population can withstand the pressure of its highly productive neighbour to the south.

Canada's peculiar geophysical position, including her proximity to the United States, has coloured the industrial face of the country. The world's demand for her stores of base metals, nickel, asbestos and iron ore, agricultural and forest products, oil and gas, has naturally directed Canadian energies to the extractive and other primary industries. In addition to the high proportion employed in petrochemical and other heavy chemical manufacturing, chemical engineers are concentrated in petroleum refining, pulp and paper, and chemical metallurgy, in that order (see Table 1).

There seems little prospect of the growth process of these industries being stunted in the foreseeable future. Certainly those enumerated above have indicated no slow-down in their expansion of productive capacities. Over half a billion dollars were spent by pulp and paper mills on new facilities in 1956 and 1957, while the chemical industry invested \$260 million and the oil refining companies \$230 million in the same period.

Shortage of chemical engineers

Another indication of the breakneck speed at which the process industries are expanding is the strain being placed on professionally and technically trained personnel at all levels. A Labour Department survey in 1956 reported that during 1957 and 1958 requirements for chemical engineers were expected to increase at an average annual rate of 13.4%. When one compares this with the fact that in 1958 only 290 Canadian graduates will be added to a pool of about 4,000 practising chemical engineers, it becomes apparent that supply is not keeping up with demand. Indeed, universities say the ratio of jobs to graduates has increased to a range from 3 : 1 to 10 : 1. Only by employing skilled immigrants is expansion possible at the present rate. While there are no available data on how immigrant engineers are employed, it is known that approximately 11,000 engineers have made Canada their home since 1951. This may be compared with the 6,682 engineer immigrants in Canada at the time of the 1951 census.

The shortage of chemical engineers is a constant source of concern to the wiser heads of industry not merely because of current difficulties in finding the right man for the right job. Despite a commendable increase in the number of graduates in recent years and the extension of the number of institutions of higher learning offering chemical engineering courses (see Table 2) the graduating classes in the next few years will, if anything, be smaller than in 1958.

Part of the reason, of course, is that the students of today must be drawn from the smaller crop of ' depression

Table 1. Disposition of Chemical Engineers in Canadian Industries*

Place of employment	*No. of chemical engineers*
Chemical industry	636
Oil refining, coal products..	246
Pulp and paper	211
Non-ferrous metal products	162
Distilleries, breweries and other branches of food industry	93
Non-metallic minerals ..	86
Iron and steel	65
Textiles (including synthetic fibres)	68
Rubber products	58
Wholesale trade	121
Government service ..	117
Business service (research laboratories, engineering consultants)	361
Total	2,224

*1951 Census of Canada

Table 2. Output of Chemical Engineering Graduates from Canadian Universities

University	*Graduates in chemical engineering*				
	1955	1956	1957	1958*	1959*
Alberta	11	37	42	64	65
British Columbia	13	15	17	22	16
Ecole Polytechnique	4	10	18	6	5
Laval	5	9	10	13	6
McGill	27	35	35	36	46
Nova Scotia Tech	7	4	5	17	11
Queen's	30	42	38	40	45
Saskatchewan	13	12	15	23	14
Toronto	59	65	64	75	62
Ottawa	—	3	4	3	6
Western	—	—	—	3	—
Royal Military College	—	—	—	10	13
Totals	169	232	248	317	289

*Estimated

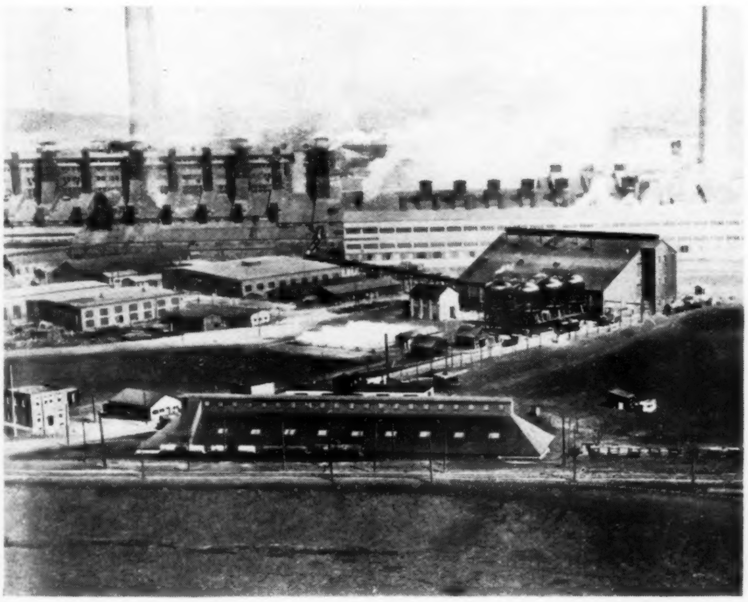
babies' of the 1930s. Moreover, Canada's education system at the secondary level is not too well geared to the needs of a rapidly growing industrial society. Then there are the young people who prefer to study south of the border. There were 86 undergraduates and postgraduates seeking chemical engineering degrees in the United States last year. To make matters worse, there is a grave deficiency of competent men on university staff to teach the incoming student body.

Chemical engineering training facilities

On the brighter side is the significant fact that, whereas from 1946 to 1953 chemical engineers constituted 5.7% of engineering graduates, the percentage has risen to 13.7. Certainly there is little to choose between the curricula available in Canada and the United States. As is the case in the U.S., much more time is being devoted to chemical engineering subjects than to those relating to pure chemistry. Stoichiometry, unit operations, chemical engineering thermodynamics, process design and instrumentation are included in standard courses today, while more mathematics is being taught to keep the undergraduate up with new advances—highly theoretical—in the field.

All universities have installed modern laboratory apparatus to study problems of unit operations involving fluid flow, heat transfer, evaporation, distillation, absorption, drying, filtration and humidification. Two institutions—the University of Toronto and McGill—offer doctorate training for graduates, whereas most others accept 'masters' candidates. The postgraduate work usually emphasises research and theses based on current provincial problems. The University of British Columbia specialises in corrosion and metallurgical problems, Alberta in oil and petroleum studies, Toronto and McGill in pulp and paper, and Queen's in diffusion problems.

The young engineer fresh out of the classroom differs from his colleague in pure chemistry in that he is not so easily lured to the United States by the prospect of higher pay and greater opportunity. No statistics are on hand to support this claim, but a sampling of particular graduate classes has shown it to be substantially true.



The close tie between industry and chemistry in Canada is illustrated by these plants at Copper Cliff, Ontario. In the foreground is the chemical plant of the I.C.I. subsidiary, Canadian Industries Ltd., which produces sulphuric acid from waste fumes from the adjoining smelter of the International Nickel Co.

Imported technology

Canadians may staff the engineering companies or the engineering departments of the larger industrial firms, but the imprint of U.S., U.K. or other outside technology is evident everywhere. It is evident in the very origin of those organisations specialising in chemical engineering and design. Canadian Kellogg, Catalytic Construction, Lummus, Stone & Webster, Girdler, Fluor and Foster-Wheeler have their American counter-

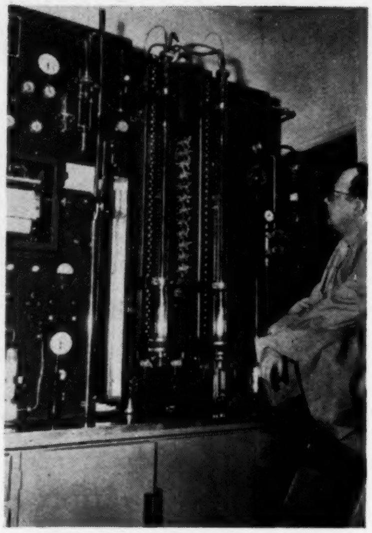
parts, whereas Humphreys & Glasgow is an example of a British subsidiary operating in Canada. The parent firm had initially been called in to build a certain plant and created a subsidiary outfit as the increased industrialisation of Canada warranted permanent offices in the country.

Similarly most chemical, rubber and petroleum refining companies in Canada are financially tied to U.S. and U.K. firms and rely on them for much of the basic process design. The pulp and paper industry, in which Canada has shown considerable technical leadership, is one illustration of a reversal in direction of the main flow of ideas.

Petroleum refining is perhaps a typical example. The newest cracking, reforming or polymerisation processes are being continually introduced in Canada. They must be; no company can afford to fall behind in the race to keep the octane number of its motor gasoline up to the market standards. Canadian roads have too large a number of automobiles with high compression ratio engines to permit otherwise. The catalytic cracking of petroleum stocks, scarcely practised outside of the United States before 1946, is now taken for granted in Canada. Refineries in the country are capable of handling 775,000 bbl./day, of which 336,000 barrels undergo cracking. The catalytic methods, using the better-known fluid-bed techniques, predominate. Thus Canadian Petrofina utilises the *Houdriflow* process at Montreal East, Shell Oil and Imperial Oil use variations developed by their parent companies, while British American Oil had an *Orthoflow* unit installed at Clarkson, Ontario, by Kellogg. *Platforming* units, based on the design of Universal Oil Products of Chicago, have been installed in several of the larger refineries.

Another example of the import of engineering ideas is illustrated in the design of the Sun Oil refinery at Sarnia. Houdry Process devised a *Houdrisid* reactor to increase the production of gasoline and lighter fuels. After some test operations the Sarnia refinery was so arranged that it could operate either the *Houdrisid* or conventional *Houdriflow* process even though the plant was originally designed for the latter.

The prominence of catalytic cracking and reforming in petroleum engineering has channelled major research into a study of catalytic reactions based on the flow of non-Newtonian fluids. Petroleum companies are sponsoring, in conjunction with the National Research Council and provincial research bodies, experimental work in fluidised-bed techniques on problems ranging from the high-temperature coking of crude oil for the production of coke and olefine-rich gas to the oxidation of ethylene to ethylene oxide with the Cambron silver catalyst.



Podbielniak machine for testing gases at the Shell refinery at Montreal East.

Special problems of Canadian industry

But whereas design is based on processes developed elsewhere, Canadian engineers have to cope with conditions peculiar to the country. When a refinery is erected in Canada, consideration must be given to the severity of the winters. In addition to attention that must be paid to the insulation of process and steam lines and the heating of different tanks and equipment, the selection of processes is important. Thus Canadian Petrofina chose an *Ultraformer* unit (Standard Oil of Indiana) over others precisely because production of butane — a difficult hydrocarbon to dispose of in a cold country—is low. The company employed a fluid coking instead of the delayed coking process on its vacuum bottoms. One factor in this choice was the difficulty in using spraying water for delayed coking in winter time.

As decisive an element as climate in influencing chemical engineering is that of economics. The limitations in market often require the erection of smaller facilities than those developed for the same product in other lands. Pilot-plant experience must often be by-passed and revisions must be made in the processes.

Petroleum chemicals

Canada's petrochemical industry is often rated as 10 to 20 years behind its U.S. counterpart. Whereas syntheses based on the aliphatic hydrocarbons available in the Texas Gulf area began in the 1920s, it was not until the 1940s that refinery capacities reached the critical mark in Sarnia and Montreal and the exploitation began of the Alberta oil and gas fields, thus permitting petrochemicals to come into their own in Canada. The war-time plants—GR-S rubber at Sarnia and ammonia and nitrates at Calgary—were engineered by U.S. companies. Standard Oil designs were used for the isobutylene extraction, butadiene and butyl units at Sarnia, while the engineering was by Stone & Webster and E. B. Badger (Boston). Dow Chemical (Midland) designed and engineered the styrene unit and Blaw-Knox (Pittsburgh) designed and Turnbull (Cleveland) engineered the GR-S unit. The ammonia synthesis and ammonium nitrate plants at Calgary were the work of Chemical Construction (New York).

The heavy dependence on U.S. and U.K. technology has continued into the post-war years. Celanese's Bishop, Texas, petrochemical plant was duplicated in Edmonton for Canadian Chemicals; I.C.I. built a *Terylene* plant for its subsidiary, Canadian Industries Ltd., and supplied C.I.L. with the necessary design data to build a polythene plant. Du Pont, Dow, Carbide, Davison and many others have supplied the know-how for the plants built by their Canadian affiliates.

A few firms like Shawinigan, or Electric Reduction—an Albright & Wilson subsidiary—are more self-reliant. But even Shawinigan, whose research, development and engineering staffs compare favourably with many in the bigger countries, has had recourse to techniques and processes elsewhere. The Hercules/Distillers cumene process for phenol and acetone had hardly been published when Shawinigan teamed with British American Oil to become the first in North America to make phenol by this route. Shawinigan has also collaborated with Heyden to form St. Maurice Chemicals, manufacturers of formaldehyde and pentaerythritol.

But when one speaks of the Canadian petrochemical industry as a decade behind that of United States, it applies only in a particular sense. The range of petrochemicals is less;

Canada's limited domestic market is responsible for that, but the engineering is comparable. Thus the Bakelite Co. at Belleville, Ontario, has perhaps the largest phenolic resin reactor—with a capacity of 3,000 Imp. gal.—on the continent. Canadian Chemicals uses as elaborate a combination of straight distillation, azeotropic distillation, extractive distillation and liquid-liquid extraction as its parent company does in purifying its oxygenated butanes and propanes (acetaldehyde, propylene oxide, acetone, methanol, n-propyl alcohol, higher alcohols and solvents).

Pulp and paper advances

Engineering research has been most fruitful in pulp and paper—Canada's top export industry. Traditionally research-minded, the industry and its research institute in Montreal have made giant strides in applying chemical engineering principles to the manufacture of these wood products. A few developments are worthy of mention:

(*a*) The use of chlorine dioxide has produced a new high in whiteness for bleached sulphate pulp. Several kraft mills have added a chlorine dioxide unit as an auxiliary to their chlorine gas treatment. The newer mills have also incorporated chlorine dioxide generators.

(*b*) Ammonia-based sulphite pulping is being widely used—even though no good recovery process is so far available. A Canadian company also pioneered the magnesia-base liquor—which has the advantage of making the spent liquor recoverable—in the 1930s.

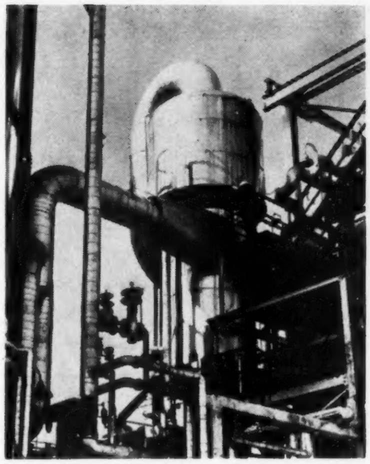
(*c*) An Alberta mill has the largest continuous pulping system on the continent. Northwestern Pulp & Power, using the Swedish *Kamyr* process, digests 500 tons of high-quality wood per day.

(*d*) The research institute has devised the ' atomised suspension technique ' to accomplish greater recovery of chemicals in effluents. While still in the development stage, successful application of this method could open great vistas for chemical engineering.

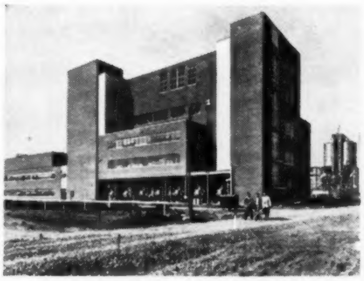
Mining and other developments

The demand for wood products should grow in future years not only because of population increase but because new processes and end-uses are being found. The newer techniques—continuous processes, chemical recovery of effluents—impinge directly on the field of the chemical engineer.

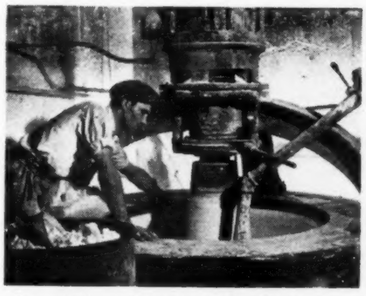
Chemical metallurgy is another arena in which Canadian engineering



A view of the Shellburn refinery, near Vancouver, giving a close-up of the vacuum flasher, in which heavy residue from the distillation of crude oil is heated and re-distilled under vacuum to produce feedstock for the catalytic cracking unit and a variety of heavier asphaltic materials.



Polymer building of the ' Terylene ' plant of Canadian Industries Ltd. at Millhaven, on the shores of Lake Ontario. This plant, opened in 1955, illustrates that Imperial Chemical Industries production capacity is expanding abroad as well as at home.



Chemical engineering manifests itself not only in Canada's glittering new refineries and automated chemical plants but also in processes where more conventional, less spectacular equipment is used, such as this centrifugal extractor for the processing of sulpha drugs, seen here in the Mallinckrodt chemical works, Montreal.

has attained its laurels. The most notable in recent years was the leaching process worked out by Prof. Forward of the University of British Columbia. Prof. Forward, engaged on the research programme initiated by Sherritt Gordon Mines for the purpose of arriving at an economical method of separating the nickel and copper in its ore deposits, observed in early 1948 that sulphides of nickel, copper and cobalt could be dissolved by an aqueous solution of ammonia without previous roasting and reduction of the ore concentrate. The result was a $25-million chemical metallurgical plant and ammonia unit at Fort Saskatchewan by 1954.

The upsurge in uranium mining has prompted a corresponding concern with engineering problems peculiar to this newest industry. Carbonate and acid leaching are both practised in Canada and refining of the ' yellow cake ' has commenced. A novel aspect is the recent formation of the Dow-Tinto company to investigate the separation of thorium from the leached ores.

Atomic energy development will open opportunities for chemical engineering in other ways. Improvement in solvent extraction processes for separation of fission products, the refinement of distillation processes for heavy-water products and the replacement of materials used as fuel rods in nuclear reactors represent some of the challenges.

Also in the future is further work on the development of the vast reserves of oil to be found in the Athabaska tar sands that cover most of north-eastern Alberta. The Research Council of Alberta had operated a pilot plant at Bitumount for some time and is now investigating other factors controlling solids flow. Royalite Oil, which is considering centrifugal means of extracting the oil from the sand, has indicated that it will spend up to $50 million in its engineering studies.

Although Canada will continue to lean on foreign technology for many years to come, the rapid industrialisation of this nation heralds the day when the complexity of chemical processing in Canada will produce a corresponding body of engineers self-sufficient in engineering and plant techniques.

Colorado minerals. A new publication covering the field of Colorado's minerals has been published by the Colorado School of Mines, called ' Mineral Industries Bulletin.'

Letter to the Editor

Science and Technology at Universities

Dear Sir,

I was interested to read the letter from Mr. Purchas in your February issue in which he makes certain comments on science teaching at universities. I feel that, despite the elegant way in which Mr. Purchas makes his points, he has done nothing more than state what is obvious to all the teachers of science and engineering whom I know. I think the vast majority of lecturers and teachers in universities and colleges who are concerned with science or technology subjects all believe that, in the words of Dr. Rabbi, their subject should be taught as an intellectual pursuit rather than a body of tricks. The real argument centres around how this should best be done. It is one thing to ask as Mr. Purchas does for this to be deliberately adopted as a general dynamic policy and quite another to translate this high-sounding phrase into practical syllabuses. However in my own subject—chemical engineering—it seems to me there is a near perfect example of how this approach is being implemented in a technological field. This is illustrated by the way in which the present-day courses are developing by emphasising the scientific nature of the engineering processes which we study in this subject. To take just one small example, the old idea of unit operations in their watertight compartments is now completely outmoded at least in teaching and there is an ever-increasing tendency to emphasise the essential unity of these operations.

I would like to suggest that those in charge of teaching science and technology are well aware of the dangers of too narrow an approach and are adequately safeguarding themselves and their students from this. If one were cynical one might even suggest that if anything needs safeguarding it is the teachers from the efforts of the well-meaning amateurs who often bedevil education at all levels and in particular in the higher fields. There is in my view a very real danger that in making these arguments about ways and means too frequent and too public we are inviting attacks on the value of higher technological education, which those who fear the growing power and influence of science in other spheres are sometimes all too ready to make. Sterile arguments about arts *v.* sciences have gone on too long and we should concentrate on making the most of our opportunities, which will only last for a relatively short time, to produce the scientists and technologists this country so urgently requires.

Yours faithfully,

D. C. FRESHWATER

113 Rothley Road,
Mountsorrel,
Nr. Loughborough,
Leics.

Gas desulphurising and sulphuric acid plant

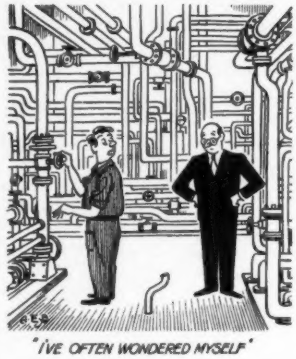
An order for a complete new A.S. coke-oven gas desulphurising plant with attached wet-contact sulphuric acid plant is being executed by F. J. Collin (U.K.) Ltd. The plant will be erected on the premises of Stewarts & Lloyds Ltd. at their works at Corby, and is their second plant of this type, the first having been installed in 1952.

The plant is designed for desulphurisation of about 17½ million cu.ft. of coke-oven gas per day for the first stage of the works extension scheme now in progress at Corby. The capacity of the desulphurisation plant can be increased 100% by installing only a small quantity of additional equipment. In the first instance the throughput of the plant will be about 11 million cu.ft./day of coke-oven gas. The A.S. desulphurising plant is the design of F. J. Collin and the equipment required will be of British manufacture.

At normal gas throughput the wet-contact sulphuric acid plant will have a rated capacity of about 23 tons of 78% acid, but this output can also be doubled by the installation of a minimum amount of additional equipment. During the early stages of operation the plant will be working at an output of 13 tons/day of acid.

The order for the wet-contact sulphuric acid plant has been placed by F. J. Collin (U.K.) Ltd. with the Power-Gas Corporation Ltd., of Stockton-on-Tees. Both the new and the existing acid plant installations are to the design of Chemiebau Dr. A. Zieren GmbH., who are associated with the Power-Gas Corporation Ltd. in this field.

Comical Engineering Corner



'I'VE OFTEN WONDERED MYSELF'

Adding colour to factory safety

The establishment throughout industry of a universal system of colours for the identification of hazards and safety equipment is the aim of the British Standards Institution's recently published recommendations on 'Safety Colours in Industry' (B.S. 2929). Three colours are involved: red, which would be taken to mean 'stop'; orange-yellow, giving a warning of danger; and green, for use in identifying or locating safety equipment and safety routes.

Contrasting colours are used with the three main colours to form patterns which make for easier visibility. Thus a red-and-white chequered pattern would be used for the door of a store containing petroleum spirit. Geometrical forms—a circle, triangle or rectangle—may be used as part of a safety message, but the colour in which they are painted and their meaning will always be the same. A circle, for instance, is to be carried out in red (or red and white) and implies an order of some kind.

One of the most revolutionary of the recommendations is that a green cross should replace the familiar red one on first-aid cabinets, etc., but this, like most of the other recommendations, is in line with the international code worked out by the International Organisation for Standardisation.

Another recent British Standard (B.S. 2095) deals with industrial safety helmets.

Hoppers for the weighing or storage of fluffy, difficult-to-handle dry materials are described in product data sheet 5704, offered by the Richardson Scale Co., Clifton, N.J., U.S.A.

WHAT'S NEWS about

★ **Plant**
★ **Equipment**
★ **Materials**
★ **Processes**

This illustrated report on recent developments is associated with a reader service that is operated free of charge by our Enquiry Bureau. Each item appearing in these pages has a reference number appended to it; to obtain more information, fill in the top postcard attached, giving the appropriate reference number(s), and post the card (no stamp required in the United Kingdom).

Agitation of viscous materials

A unit for mixing, homogenising and dissolving materials of high viscosity, marketed by Moritz Chemical Engineering Co. Ltd., is based upon the use of an impeller with specially designed cutting vanes and an outer stationary crown which acts not only as a baffle but increases the cutting action of the blades. The impeller is large in diameter and bears close relation to the diameter of the vessel in order that it may operate without cavitation in very viscous mediums.

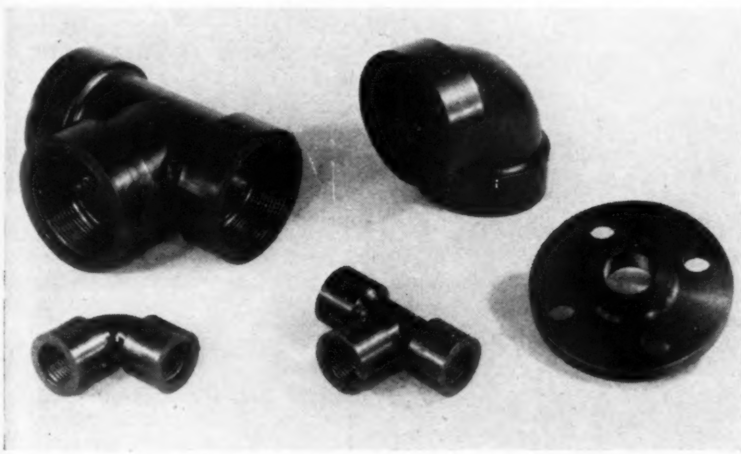
The vessel is provided with bottom entry drive, thus leaving the top of the vessel free. The impeller shaft and gland are adjusted on the upward shaft extension of a reduction gear unit, the latter forming the base supporting the vessel. As the gland is mounted not on the bottom of the vessel but on a machined flange centred in relation to the impeller, alignment is assured. The section of the shaft passing through the gland is chromium plated and polished.

The *Turbo-Cleaver* is available in four sizes. **CPE 866**

Purity meter auxiliaries

Three instruments have been designed to widen the range of applications of the *Dionic* water-purity meter produced by Evershed & Vignoles Ltd. (see page 139).

A water cooler reduces very high-temperature test water to a temperature within the working range (60 to 160°F.) of the water-purity meter, whilst the steam condenser reduces test steam to condensate at a temperature suitable for testing. The degree of steam purity attained in some industries nowadays is so high—*i.e.* the dissolved organic salt content is so low—that the readings of the purity meter can be seriously influenced by any soluble gases present in the test condensate, and the Evershed-Straub degassing condenser is provided to overcome this difficulty. **CPE 867**



Examples of polythene screwed fittings as described on this page.

Polythene screwed fittings

Moulded polythene fittings with deep B.S.P. threaded socket ends designed to fit on to standard pipe threads cut on heavy-gauge polythene tube now makes possible many more applications of polythene tube for handling corrosive liquids.

The present range is of tees, 90° elbow bends, flanges with thickened centre boss, couplings, reducers, plugs, caps, nipples and unions in $\frac{3}{8}$-in., $\frac{3}{4}$-in. 1-in., $1\frac{1}{4}$-in., $1\frac{1}{2}$-in. and 2-in. bore sizes.

For users not wishing to do their own seal welding, made-up flanged sections for easy on-site installations are available from the makers, Industrial & Marine Protective Applications Ltd. **CPE 868**

Viscosity measurement

Three types of Höppler viscometers which are manufactured by Gebrüder Haake of Western Germany are being marketed in Britain by P. K. Dutt & Co. Ltd. The three types are the Model BH, for precision work, with an electric heater; Model B, the same precision model but without the heater; and Model CH, a cheaper industrial model with heater.

The viscometer comprises essentially two glass tubes, the smaller,

C.P.E.'S MONTHLY REPORT AND READER SERVICE

inner tube containing the fluid to be measured and through which the measuring ball passes and the outer tube acting as a water bath for keeping the temperature constant. The instrument is provided with a thermometer for temperature observation. A number of balls are provided to cover various ranges of measurement.

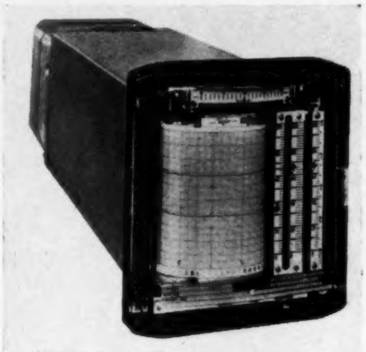
The BH model is claimed to give an accuracy of measurement of $\pm 0.1\%$ to 0.5% and to cover a temperature range of from –60 to $+150^\circ$C. An advantage claimed for this system is that there is no falsification of results owing to surface tension, evaporation, skin formation or retention of fluid residues within the measuring chamber.

Particulars of the CH model are the same as for the BH except that in this case the accuracy claimed is $\pm 1\%$ and the temperature range from –35 to $+100^\circ$C. **CPE 869**

Sight flow indicators up to 8-in. bore

Sight flow indicators of 8-in. bore have recently been introduced with *Armourplate* glass windows 1½-in. thick. They are of the flap pattern and appear in a range of indicators (including a number of other patterns) of ¼-in. to 8-in. bore. Indicators specially designed for the chemical industry are made in angle types of 90°, giving a clear view by bringing the spout into a large-diameter body, the branches being offset tangentially to the body.

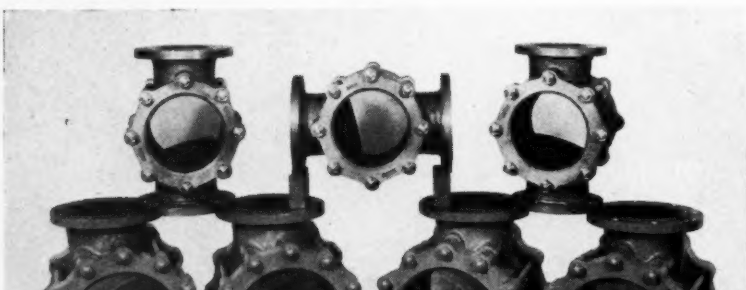
A three-view angle type is available with a window on top which can be used for additional illumination. This model is useful for a pipeline on the floor when the outlet pipe goes down



'Transcope' recorder

to the plant below or up on a staging, in which case an angled mirror mounted above will show the flow conveniently from below.

Straight-through types are also available. Ends of body can be flanged to B.S.T. 'D' or 'F' and to A.S.A. Standard or in the smaller sizes can be screwed B.S.P.T. or A.P.I. threads. B. Rhodes & Son. **CPE 870**



Sight flow indicators

Plastic-coated steel

Plastic-coated steel sheet is available which can be worked and treated as ordinary steel sheet, while its outer surface retains all the characteristics of PVC plastic, produced in a varied range of colours and embossed patterns. It is stated that *Stelvetite*, as it is called, is cheaper than stainless steel.

Developed by John Summers & Sons Ltd., in conjunction with B.X. Plastics Ltd., *Stelvetite* is strip-mill, cold-reduced steel with a specially formulated *Velbex* PVC coating. The reverse side of the sheet can be either a bonderised steel or electro-zinc-coated surface. It can be bent, formed, seamed, deep drawn, joined and welded without damaging the coating, and is claimed to be highly resistant to acids, alkalis, greases, detergents, weather, humidity, and to abrasion. It does not support combustion, and is stable at higher temperatures than PVC alone.

CPE 872

ALUMINIUM PLATE UP TO 11-FT. WIDE

Aluminium plate for general engineering purposes is now available in Britain in widths up to 11 ft., being produced by Northern Aluminium Co. Ltd. by butt-welding two plates together in a special jig. The weld bead is ground flush and the resulting wide plate is comparable in appearance with normal rolled material. It is claimed that the strength of the weld is higher than can be ensured by welding during subsequent fabrication.

In the usual alloys and gauges chosen for welded aluminium equipment, plate can be supplied up to 30 ft. × 11 ft. **CPE 871**

Three new instruments

Three new instruments produced by Taylor Controls Ltd. include the *Transcope* recorder, an instrument of the miniature series, with panel cutout 6 in. × 6 in. Among the features of this recorder are the *Servomatic* power pens—150 times more powerful than the conventional type. Among other points worth noting are that it has 0.1% threshold sensitivity, includes a full 4-in. 30-day chart, and receives three recorded or indicated variables.

Another new model, the potentiometer transmitter, represents a unique concept in a bridge-balancing potentiometer. This transmitter embodies an electronic circuit which eliminates need for a slidewire, battery, standard cell, or moving parts. Transmission is electrical and/or pneumatic.

In conjunction with the *Transcope* recorder, there is the *Transcope* controller, which is a non-indicating miniature pneumatic instrument, utilising metallic bellows as pressure receivers. According to the makers, it is characterised by easy maintenance, and compatibility with the *Transcope* pneumatic receiver to provide controller adjustments from the front of the receiver. **CPE 873**

Purity testing

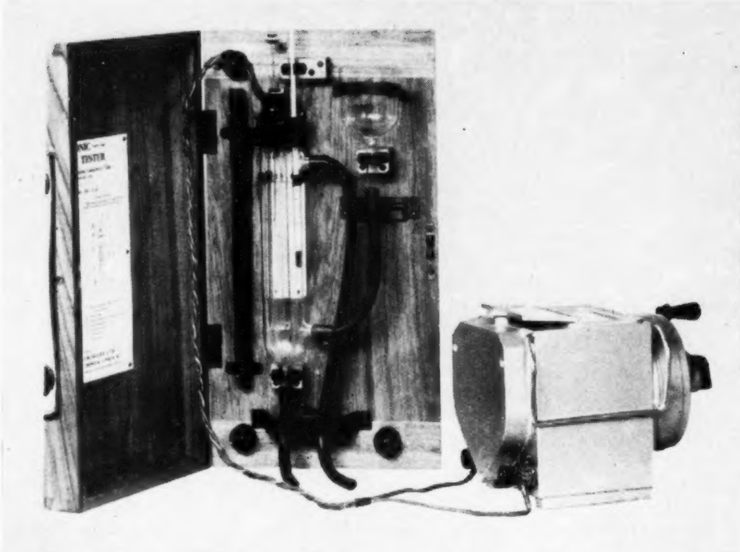
A simple means of detecting and estimating the amount of inorganic impurities dissolved in water or steam is provided by *Dionic* instruments.

They facilitate the satisfactory operation of boiler plants, for instance, since they can measure the purity of the output steam, that of the feed water, of the condensate from surface condensers, and of the water from the evaporators. They can also be installed to give a continuous record of boiler concentration.

The working principle on which these instruments depend is the fact that the electrical conductivity of a dilute aqueous solution is directly proportional to the amount of inorganic impurity in that solution: it follows that an instrument for measuring the electrical conductivity of the solution will therefore give an indication of its purity as well.

The method is sufficiently sensitive to reveal the presence in solution of minute impurities, which might well escape detection by chemical methods, and it has the advantages of speed and simplicity.

Wherever an ionisible substance is present in a liquid of little or no inherent electrical conductivity, there is a possible field for the use of *Dionic* instruments, state Evershed & Vignoles Ltd. **CPE 874**



Portable version of 'Dionic' water tester which consists of two units, a conductivity tube and conductivity meter, and is used for carrying out individual purity tests.

Molecular distillation

Molecular distillation offers advantages when heat-sensitive or high mol. wt. (above 250) compounds require processing, since such processing takes place at the lowest temperature possible and the contact time with the heating surface is a minimum. Furthermore, vapour compositions which result from a mixture in the heating surface are dependent not only on the vapour pressures of the pure components but on their mol. wt. Consequently, materials having identical vapour pressures can be separated provided their mol. wt. are substantially different.

The Scott-Smith molecular still is a jacketed, falling-film unit, continuously operated under a wide range of controlled conditions. High operating vacuum is achieved by oil diffusion pumps backed by steam ejectors or mechanical pumps, and the residual air pressure within the apparatus is reduced to 0.00005 mm. mercury absolute pressure, and less. Since under these conditions ebullition in the liquid does not take place, means must be provided to promote rapid diffusion of volatile molecules. In the Scott-Smith still this is achieved by a variable-speed rotating wiper which produces a thin uniform liquor film on the heating surface. The wiper has detachable slotted *Fluon* or carbon blades, which are easily adjustable to accelerate or retard the liquor flow over the heating surface. Within the still, a thin tube parallel condenser and a rotary entrainment separator are provided. The former is arranged to give a short path flight of the molecules from the heating surface and the latter is driven from the wiper mechanism.

Details are available from George Scott & Son Ltd. or from the CPE Enquiry Bureau, quoting **CPE 875**

Molecular still.

Temperature recorder

A new temperature recorder which records any number of independent temperature points from one to six incorporates a conventional galvanometer, a chart and chart-drive mechanism, recording mechanism, automatic ribbon-mechanism and an automatic station selector and indicator.

The recording chart has a calibrated width of 6 in. At a speed of 1 in./hr., it runs continuously for 30 days and it will also run at speeds of ½ in. or 2 in./hr., if desired.

Ether Ltd., the makers of this instrument, also announce another new temperature-controller, the *Thermal-trol* type 750, which employs no galvanometer and has an extremely wide range, being able to control temperatures between −328°F. and +1,832°F. (−200°C. and +1,000°C.) for electrical, steam, gas or oil-fired apparatus.

The temperature-sensitive element in this controller is a platinum-wire resistance, or thermo-bulb, in which the resistance changes in proportion to its temperature, thus causing an unbalanced condition in the a.c.

bridge-circuit. A relay opens or closes an electrical circuit, depending on the phase angle of the input voltage to the amplifier. According to the makers, this system is independent of amplifier-gain and is extremely stable. **CPE 876**

Re-refining of waste oils and solvents

Re-use of used oil, petrol, turpentine, kerosene, nitrosolvents, trichlorethylene, etc., is made possible by the Schlegel system which comes from Germany and is available in the United Kingdom from Liquid Systems Ltd.

Schlegel regenerators, which combine distillation, adsorption and filtration, work on a physical-chemical principle and are simple to operate. A small quantity of refining agent is put into the open regenerator and thoroughly mixed with the waste oil. The lid is closed and, by means of a hand pump or compressor, the inside pressure is raised to approximately 36 p.s.i. Further processing is completely automatic. When the entire charge has been completely processed, the heating is switched off automatically and the regenerator does not require further attention. The residue remaining after the regenerating process is a dry compressed cake which is easily removed by a scraper in a matter of moments.

Two small models have capacities of 3.3 gal. and 9.9 gal. respectively and larger models are available up to a maximum capacity of 88 gal. **CPE 878**

SIGNS OF INDUSTRY

A visitor to the works of Bribond Ltd. might expect to be assailed on all sides by notices bearing such slogans as 'Danger—No Lights,' 'Emergency Exit,' 'Keep Off,' 'First Aid Post,' 'No Road' and 'Beware of the Crane.' He might also be perplexed at the number of notices saying 'Ladies' or 'Gents,' 'No Parking' or 'Dogs Not Allowed.' But there would be no need to worry, for the company's business is the manufacture of industrial and general signs.

These signs are claimed to have exceptionally long life owing to the materials and manner of their construction. In the Bribond process, a core of resin-impregnated fibrous material is bonded on both sides with sheets of lithophone impregnated with colourless resin. The printed matter or photostat is placed on one side and covered with a sheet of alpha material carrying a high percentage of bonding matter. This 'pack' is then cured under closely controlled temperature to produce a homogeneous unit.

It is stated that the signs are unaffected by weather or extremes of temperature, will not chip or crack, are proof against oil, grease and chemicals, will not corrode and possess high electrical insulation properties. Since the message is protected under the transparent surface, maintenance is confined to occasional cleaning with a damp cloth. **CPE 877**

Glandless stop-valve

Stated to be suitable for controlling the flow of almost any fluid and gas up to a maximum temperature of 100°C., a stop valve known as the *Rayon-Patent* has its upper part so shaped that the movable parts of the valve remain isolated from the liquid, completely eliminating the need for packing glands.

The valve is available either screwed or flanged and is claimed to be suitable for all liquids including acids, corrosive fluids and brine. The body is available in cast iron, malleable iron, bronze, aluminium or lined with hard rubber or plastic. The method employed in lining the valve body ensures that the valve is also suitable for use in absolute vacuum.

With the development of a nylon clack the *Rayon-Patent* valve is suitable for the control of petrol, oils, solvents and many materials that previously have had a severe effect upon rubber or synthetic rubber.

Other features of the valve, according to Meynell & Sons Ltd., the makers, include:

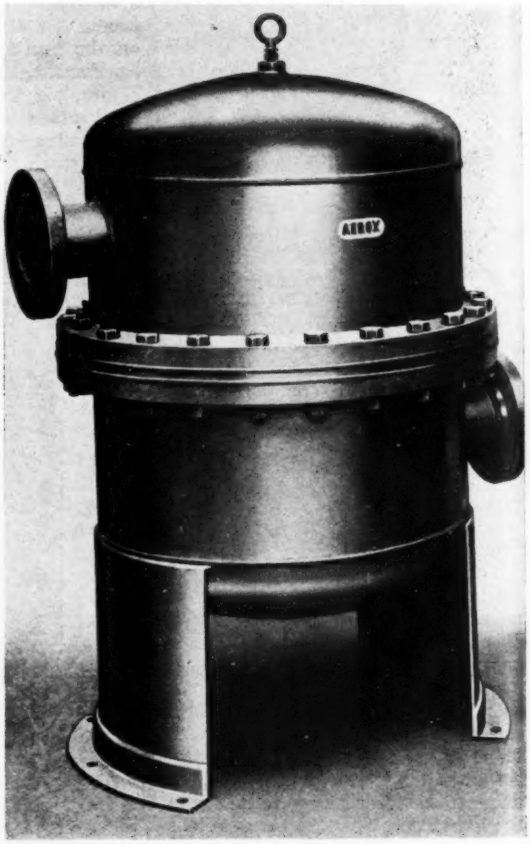
(1) Perfect sealing due to the fact that the rubber black fits exactly into a formed depression avoiding distortion of the valve clack.

(2) No danger of rapid wear when using for regulating purposes.

(3) Clear, unrestricted way, reducing pressure drop to almost nil.

(4) Clear indication from outside when the valve is opened or closed.

(5) Exceptionally long life with very little maintenance costs. **CPE 879**

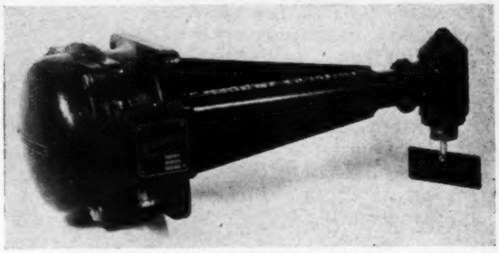


Porous ceramic filtration units are available for air, gas and liquid applications up to pressures of 700 p.s.i. A consultative development service is offered by the makers, Aerox Ltd., to those with special filtration requirements. CPE 880

BUNKER LEVEL INDICATOR

Automatic control of bunker levels is achieved by the use of this device, which can be used with such materials as coal and coal dust, grain, plant husks, sawdust, soap flakes, dried milk, etc. The rotating paddle shaft protrudes into the bunker space and a visible or audible warning is given when the bunker level drops below a certain limit. The horizontal model is shown here; more commonly used is the vertical model which may have a shaft length of anything between 8 in. and 20 ft. British suppliers are Smail Sons & Co. Ltd.

CPE 881



Hydraulic stop valves

A series of globe stop valves is being marketed by Robert Harlow & Son Ltd. for heavy-duty cold hydraulic service. The maximum working pressures are from 2,000 p.s.i. in the $\frac{1}{4}$-in. size to 1,000 p.s.i. in the 2-in. size.

All sizes have bodies, stuffing boxes and disc holders in sand cast gunmetal to B.S. 1400 LG2-C, spindles in high-tensile manganese bronze, and flat fibre discs which ensure absolute pressure tightness when the valve is closed. Robust, serrated edge, cast-iron handwheels are standardised.

A feature of the larger sizes o valves is that the glands can be re-packed when the valves are fully open and under pressure. **CPE 882**

Extracting iron from powdered and granular materials

A magnetic apparatus for extracting finely abraded iron present in PVC or other plastics, announced by Rapid Magnetic Machines Ltd., can also be used for the removal of fine iron particles from any other material in granular or powder form. The operating technique is briefly as follows:

The material is fed into a hopper which incorporates an adjustable feed gate, and flows down a chute. Above this chute is suspended a stationary suspension magnet of very high intensity, fitted with two pole pieces suitably positioned across the feed to provide a field of deep penetration. The extractor is enclosed in a sheet-steel housing. The iron contamination is attracted and held by the magnet pole shoes whilst the cleaned product passes forward to the next process.

Suitable vibrators can be fitted to both the feed hopper and the feed chute in cases where material is not free flowing.

The extractor is produced in several widths and a capacity of approximately 600 lb./hr. is possible on a 3-in.-wide model when handling PVC granules.

CPE 883

Suppressing fumes and steam in metal treatment baths

The Paints Division of I.C.I. has introduced a new process—the *Serseal* layer process—for eliminating fumes and steam from aqueous metal treatment baths and for reducing heating costs.

The process seals the surface of the processing liquid in the bath with a layer of inert material and this not only checks fumes and steam but also reduces the amount of heat needed to keep the bath at a working temperature. By using *Serseal*, they claim that fuel economies of up to 75% have been recorded under production conditions. Because the layer eliminates steam and condensation, exhausting equipment can often be dispensed with. Working conditions are improved and shop condensation and structural corrosion are retarded.

Alternative grades of *Serseal* are available to suppress acid fumes and spray from pickling tanks and to conserve heating in alkaline paint-stripping vats. **CPE 884**

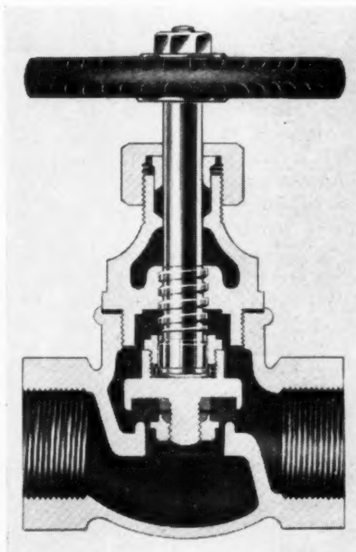
Type E300 electric oven

Batch ovens

A new range of general-purpose, electrically heated industrial tray loading ovens, announced by Barlow-Whitney Ltd., includes two basic types which cover operating temperatures to 150 and 300°C. respectively. Internal capacities are from 1 to 72 cu. ft. and the majority of sizes are available with natural or fan circulation.

The E 150 ovens are of all-steel, double-skin construction and the heating elements are of the totally enclosed, metal-cased type housed in the base or side walls behind anti-radiation shields. Close temperature regulation is effected by an adjustable hydraulic thermostat with separate neon indicator, all control gear being housed in the base on small bench-type ovens, except for the door thermometer. On larger sizes the controls are located in a steel case fitted at a convenient working height on the side wall.

The E 300 ovens are of somewhat heavier construction and more heavily insulated for dealing with higher temperatures. Although available with



Section through hydraulic stop valve.

natural ventilation, the types chiefly in demand by industrial users are those fitted with full forced circulation with either horizontal air flow (H.A.F.) or vertical air flow (V.A.F.), the choice being determined by the nature of the work to be processed.

Optional features include the incorporation of explosion reliefs when ovens are required for processes which release inflammable gases, giving rise to explosive hazards. These provide efficient thermal insulation but disintegrate immediately upon any marked increase of internal pressure. When the process results in the release of toxic fumes injurious to operator's health, a special ventilation arrangement can be incorporated which prevents the escape of these fumes into the workshop. **CPE 885**

Closed-circuit television

Industrial television, regarded at first as just another ' novelty,' is now becoming established as a useful industrial tool which can take its place on equal terms with other instruments and techniques. A high proportion of cameras now in operation are used for the remote observation, inspection or control of processes and operations which are too dangerous, too inaccessible, too uncomfortable or too detailed for naked-eye viewing. Others do a job more efficiently and more economically than a human observer can.

Equipment being offered by Pye Ltd. consists of three basic units—camera head, control unit and picture display monitor. The system operates on television standards of 405 lines 50 cycles, 525 lines 60 cycles, or 625 lines 50 cycles, and requires a power supply of 85 to 125 or 170 to 250 volts a.c. There are numerous examples of the use of the system in the steel, atomic energy, aircraft and other industries, as well as in research and education. Further details of the equipment are available from the company or from the C.P.E. Enquiry Bureau, quoting: **CPE 886**

★ *American Developments in Brief* ★

New impervious-graphite liquid distributor head, developed for falling-film-type absorbers by Falls Industries Inc. is claimed to provide virtually perfect liquid distribution to the tubes by use of an *Equi-lizer* principle whereby a liquid reservoir is provided to act as a dampener on any surges of entering liquid, and to force all the liquid to reach the exact same level at the same time.

Uniformity of liquid distribution is further assured by baffling gas inlet to eliminate possible turbulent effects created on the surface of the liquid by the velocity of the entering gas. **CPE 887**

★ ★ ★

Designed to control temperatures to an accuracy of $\frac{1}{2}\%$ of scale range over the extreme temperature application of –30 to 1,100° is a new mercury-actuated instrument intended for the industrial heat process and food process markets. The case features a camera-type moisture seal which also makes it dust free. For greatly improved near and far readability and setting, the instrument incorporates an *Accu-vision* dial, features of which include optically contrasting colour combination of the calibrations, pointer and background; a magnified setting pointer; hairlines for parallax sighting; and a dial area that is much larger than normal.

Further details are available from the exporters, Ad. Auriema Inc., or by making use of the C.P.E. reply-paid postcard, quoting: **CPE 888**

★ ★ ★

An ultra-high-speed radiometer developed by Radiation Electronics Corp. can remotely detect pulses of thermal radiation of 1 microsecond duration. It is stated that, owing to the high sensitivity of its infra-red sensing element over a broad spectral region, this instrument will rapidly and accurately measure thermal radiation from surfaces a few degrees above ambient to extremely high temperatures. **CPE 889**

★ ★ ★

An acetylene generator with a newly developed automatic signal system is now available from the Linde department, Union Carbide International Co., division of Union Carbide Corp. With a calcium carbide capacity of 500 lb., the unit will produce 1,000 cu.ft./hr. of medium-pressure acetylene per hour. Delivery rates of up to 2,000 cu.ft./hr. of acetylene are obtainable over shorter intermittent operating periods.

With standard regulating equipment the generator can also be used to supply low-pressure acetylene to a piping system. **CPE 890**

★ ★ ★

A new *Karbate* impervious-graphite, plate-type heat exchanger featuring an adjustable and removable elbow connection is available from Union Carbide International Co. Elbow replacements on this new-type heat exchanger can be made in the field.

The removable, bolted elbow connection is stronger than the previous cemented construction, and can be swivelled to any desired angle, providing easy connection to the steam or water piping. **CPE 891**

High-temperature thermal insulation and filtering material

Low thermal conductivity, low density, flexibility and high-temperature resistance are features of a lightweight, fibrous silica material called *Refrasil*. According to the makers, the British Refrasil Co. Ltd., it can be looked upon for most practical purposes as the flexible equivalent of solid fused silica. Like fused silica it has a high resistance to thermal shock and to acid attack. It is available in the basic forms of batt, cloth, tape, bulk fibre, sleeving, cordage and yarn.

There are a number of potential chemical engineering applications of *Refrasil*. Thus high-temperature gas filters of the pad or candle type have been made up satisfactorily from *Refrasil* batt and cloth. High-temperature gaskets can be made from the material and used successfully, provided that care is taken to ensure that excessive pressure is not applied to the joint. One particular instance of the use of *Refrasil* in this way is a tailored blanket of the material which separates an expensive platinum catalyst from a surrounding stainless-steel tube along which hot corrosive gases pass.

Tailored blankets for thermal insulation, clad in either cloth or metallic foil, can readily be fabricated to users' requirements. The main advantages of this blanket construction are flexibility, ease of assembly and removal and the precision fitting of the insulation to the job.

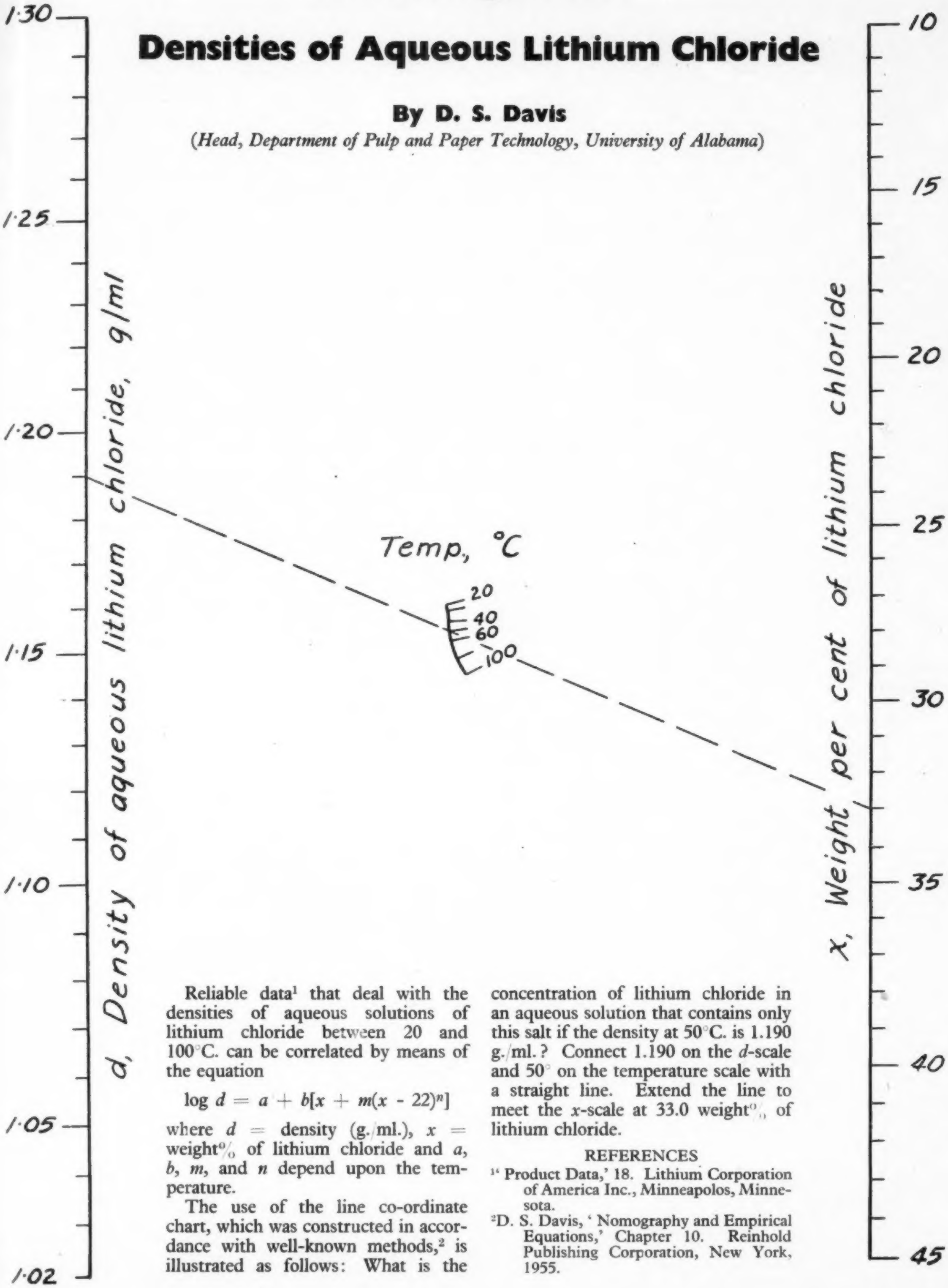
Temperatures up to 1,000°C. can be withstood, according to the makers. **CPE 892**

Nomogram:

Densities of Aqueous Lithium Chloride

By D. S. Davis

(Head, Department of Pulp and Paper Technology, University of Alabama)



Reliable data[1] that deal with the densities of aqueous solutions of lithium chloride between 20 and 100°C. can be correlated by means of the equation

$$\log d = a + b[x + m(x - 22)^n]$$

where d = density (g./ml.), x = weight% of lithium chloride and a, b, m, and n depend upon the temperature.

The use of the line co-ordinate chart, which was constructed in accordance with well-known methods,[2] is illustrated as follows: What is the concentration of lithium chloride in an aqueous solution that contains only this salt if the density at 50°C. is 1.190 g./ml.? Connect 1.190 on the d-scale and 50° on the temperature scale with a straight line. Extend the line to meet the x-scale at 33.0 weight% of lithium chloride.

REFERENCES

[1] 'Product Data,' 18. Lithium Corporation of America Inc., Minneapolos, Minnesota.

[2] D. S. Davis, 'Nomography and Empirical Equations,' Chapter 10. Reinhold Publishing Corporation, New York, 1955.

Company News

The French associates of Humphreys & Glasgow Ltd., Gaz a l'Eau et Gaz Industriel, have completed a new plant for Gaz de France at the Landy works, Paris, to reform liquid petroleum gas, or refinery or natural gas. It is primarily intended to meet peak load conditions.

This unit, employing the *Onia* autothermic catalytic process, is producing 10 million cu.ft./day of reformed gas from a feedstock of commercial butane. The reformed gas has a calorific value of 180 B.Th.U./cu.ft., and a specific gravity of 0.68; it can, if necessary, be subsequently enriched by the addition of butane.

The plant is operating at an efficiency in excess of 90% and is self-supporting in steam.

*

Northern Aluminium Co. Ltd., Aluminium Ltd.'s principal fabricating subsidiary, plans to spend £10 million over the next four years, nearly £8 million of this being for new plant and buildings. The major part of this programme will be the expansion of the company's aluminium rolling mill at Rogerstone, Monmouthshire, raising its annual capacity to 75,000 tons in such a way that a further increase will be possible—at a relatively low cost per ton—to an ultimate capacity of 175,000 tons. The remainder of the investment will be in further modernisation of the Banbury and Birmingham works.

*

Productivity at the Stone works of Quickfit & Quartz Ltd., the scientific and industrial glassware manufacturers has been increased in some cases from between four to six times by the introduction of new plant and the adoption of a new mechanised layout.

An important development leading to much greater efficiency has been introduced for the annealing process. For some time, intermediate annealing had been carried out by heated cowls which could be dropped over and lifted off the glassware. This principle, the 'top hat,' has now been applied to the final annealing of heavy-wall ware which cannot be properly annealed in a continuous lehr. An electrically heated oven has been designed which can be raised and lowered on a travelling hoist. Thus while one batch of glass is being annealed another can be prepared. Immediately the first batch is finished the second can begin, giving a considerable increase in throughput and great saving of heat.

Production in the factory is divided into two main streams: laboratory glassware and chemical plant. Q.V.F. Ltd. are the chemical engineering subsidiary of Quickfit.

*

Monsanto Chemicals (Australia) Ltd. has entered into an agreement with Drug Houses of Australia, Melbourne, to purchase all outstanding shares of two of that company's subsidiaries—Beetle Elliott Pty. Ltd. and Drug Houses of Australia (Chemicals) Pty. Ltd. Beetle Elliott manufactures plastic materials, principally phenolic urea and melamine moulding powders, as well as polyvinyl acetate emulsions, while the other company manufactures sulphuric acid, phenothiazine, some inorganic salts and various agricultural chemicals. Both companies operate plants in the Sydney and Melbourne areas.

The principal share-owners of Monsanto Chemicals (Australia) Ltd. are Monsanto Chemicals Ltd., England, and Monsanto Chemical Co. of St. Louis.

*

An additional fleet of service vans equipped to deal with major overhauls as well as routine calls has been introduced by Sharples Centrifuges Ltd. The vans are controlled from the company's head office at Camberley, Surrey, but based at strategic points throughout the country.

*

The name of the working subsidiary in Federal Germany of Chemische Fabriek 'Naarden' Holland Ltd. has been changed to Deutsche 'Naarden' GmbH. This change of name reflects the enlarged scope of the concern in question—which serves German industry as a source of supply of flavours, essential oils, vanillin, antioxidants and preservatives, perfumery compounds, glycerine, theobromine and caffeine. The works and laboratories are at Hamburg-Duvenstedt. The German subsidiary will continue to have the benefit of the results of the scientific research work carried out by the parent company in the Netherlands.

*

Durham Raw Materials Ltd. and J. M. Huber Ltd. have announced that Durham Raw Materials Ltd. have been appointed distributors in the U.K. of materials manufactured by the J. M. Huber Corporation of New York. In addition to their carbon blacks, these include *Zeolex* (an aluminium silicate reinforcing agent), *Turgum S*, *Butac* and *Nutac*, which are rubber rosins with specific uses, *Actone*, an activator/accelerator, and a range of hard clays of which there are no British equivalents.

Heavy chemical glassware being produced in the Shelley oven at the Quickfit & Quartz Ltd. factory. This electric oven, which the company themselves designed, can readily be lowered over a new batch of glassware while completed pieces cool.

Technology Notebook

Research — Education — Discussion

Distillation

Loughborough College of Technology is to have a summer school on distillation techniques, which will be held in the department of chemical engineering from July 15 to 24 inclusive. The course will cover the major design techniques in the field of distillation up to or beyond the level of the usual undergraduate honours course.

The syllabus will be divided into three parts dealing with equilibria and thermodynamics, stagewise calculations and plant design respectively, and the subject matter of the lectures will be supplemented by tutorials on each subject to give practice in the solution of typical problems. The course will also include practical work in the laboratories.

The fee for the course, including residence at a college hostel, is 30 guineas, and further information can be obtained from the Registrar, Loughborough College of Technology, Loughborough, Leics.

Scholarship scheme extended

Extensions of a scientific and technical scholarship scheme operated by Pfizer Ltd. have been announced. In future, 20 successful candidates will proceed each year to a full-time course at Canterbury Technical College and take advanced-level G.C.E. subjects. Each will receive a grant of £3 10s. per week, plus course and examination fees. At least half of the students will be selected annually for either university or ' sandwich ' courses.

In announcing the scheme Mr. P. V. Colebrook, production and research director, expressed the view that more educational schemes of this type by large and medium-size companies could help substantially to fill the gap between the country's need for scientists and technologists and its present ability to produce them.

Chemical institutes in Switzerland

The Swiss Government has submitted to Parliament the draft bill of a project concerning the extension of some of the chemical institutes attached to the Federal Polytechnical School at Zurich. The appropriation required for these extensions, and for the equipment of laboratories, lecture rooms and so on, amounts to 12½ million Swiss francs, of which sum 2,050,000 francs have already been obtained, as a donation from six important Swiss firms in the chemical industry, for the purpose of building a new institute for physical chemistry.

The Federal Polytechnical School has always reserved an important place for chemistry, both for teaching and research. Among scientists and research workers who have taught, or are still teaching, chemistry at the Federal Polytechnical School, no fewer than five professors have already received the Nobel Prize.

Progress in atomic power

The United Kingdom Atomic Energy Authority announce that they are to hold a conference at Harwell on June 11, 1958, at which recent developments in nuclear reactor technology will be discussed with representatives of British industry.

The first conference with British industry on the Authority's programme of research on advanced types of nuclear power reactor systems was held in November 1956. The conference now announced will inform industry of the progress achieved over the last 18 months.

£ s d

CHEMICAL PLANT COSTS

Cost indexes for the month of February 1958 are as follows :

Plant Construction Index **172.0**
Equipment Cost Index . . **163.5**

(June 1949 = 100)

£ s d

New chemical department

New chemical technology facilities will be opened at the Heriot Watt College, Edinburgh, on July 3. The new extensions have cost some £500,000 and will provide a full chemical technology department, with a series of physical and chemical laboratories, lecture halls, classrooms, drawing offices and other facilities. The new chemical technology department will be linked to the chemical engineering department of the College.

Automation and computation

The study of the techniques, machines, and concepts of automation, automatic control and computation has been intensified in recent years and interest has been aroused in all branches of science and industry. It was this wide spread of interest which led to the decision last year (by some 20 bodies) to set up an organisation, to be known as the British Conference on Automation and Computation, to facilitate the exchange of information regarding the activities of the individual societies within the whole subject. This new organisation has been divided into three groups, as follows: The British Group for the Engineering Applications of Automation, the British Group for Computation and Automatic Control and the British Group for the Sociological and Economic Aspects of Automation Techniques; and has now been formally constituted.

Conference on mass spectrometry

A conference on mass spectrometry is being organised by the mass spectrometry panel of the Institute of Petroleum hydrocarbon research group, and committee E-14 of the American Society for Testing Materials, and will be held in London, September 24 to 26, 1958. Further details are obtainable from Dr. R. R. Gordon, Coal Research Establishment, Stoke Orchard, Cheltenham, Gloucestershire.

New uses for tin

The production of titanium-tin alloys by powder-metallurgy methods is being investigated, with the aim of producing by this method sound titanium-tin and titanium-tin-aluminium alloys. A small experimental vacuum furnace has been used for sintering at high temperatures and at very low pressures. A preliminary investigation showed that compacts of titanium and tin powders pressed at room temperature could be sintered to give materials whose density approached that of the cast alloy.

This research is noted in the annual report of the Tin Research Institute, just published. A notable achievement of the Institute was the publication of a method of producing electroplated deposits of tin in a fully bright form. The tin deposit obtainable by electroplating has hitherto been matte and chalky in appearance and the new method produces coatings which come from the bath with the appearance of having been mechanically polished.

World News

CANADA

Sodium chlorate projects

Electric Reduction Co. of Canada Ltd. has announced immediate steps which are being taken to implement the company's overall, long-range plans of expansion and diversification in the Canadian chemical industry. The announcement, made in Toronto, follows talks in London with the parent company, Albright & Wilson Ltd., held in mid-December.

Expansion of sodium chlorate facilities in eastern Canada will consist in more than doubling the capacity of the company's plant at Buckingham, Quebec. Construction has already commenced, and completion date is scheduled for July 1958. At the same time, Electric Reduction's sodium chlorate operation in north Vancouver is being expanded by 50%.

UNITED STATES

Copper refining

Construction of a new 16,500-tons/month plant for the electrolytic refining of copper, to be designed and constructed by the M. W. Kellogg Co., New York, has been announced by the Kennecott Copper Corp., New York. The new copper refinery will be built near Baltimore, Md., at an approximate cost of $30 million. It will employ 570 people and is expected to be in operation in 1959.

In the past most of Kennecott's electrolytic refining has been done by the American Smelting and Refining Co. An agreement has been reached with that company whereby Kennecott's refining commitments to them will be reduced as from July 1, 1960, thus permitting an increase in the initial capacity of Kennecott's new refinery. An earlier plan for the refinery called for an installation with an initial capacity of 7,000 tons monthly and costing approximately $20 million.

The larger plant will be supplied with copper from Kennecott's domestic mine as well as copper from its Chilean subsidiary, Braden Copper Co. The refinery will furnish electrolytic copper for both European and U.S. markets.

Missile fuels

Pennsalt Chemicals Corp. have announced that they have started the construction of a plant to produce ammonium perchlorate for use in missile fuel systems. For some years they have been producers of sodium chlorate, the basic chemical from which ammonium perchlorate is manufactured.

They also state that they have recently perfected a larger, improved electrolytic cell for the production of elemental fluorine.

FRANCE

Carbon black

Production of carbon black started recently in a factory near the oil refinery on the Etang-de-Berre. It is planned that production should initially cover about 40% of France's needs. Later, some production may be available for export.

More sulphuric for south-east

The installation of a big new sulphuric acid unit is under way at the Saint-Gobin factory at Saint-Fons (Rhone). Production will be based on pyrites and it is reported that the purification and catalytic techniques are particularly advanced.

Starting in autumn this year, the plant will be able to produce about 330 metric tons/day of acid of all grades.

At the Usine de l'Oseraie (Vaucluse) also various new installations and improvements will increase the production of sulphuric acid.

These projects reflect the increased industrial activity in the Lyons area and in the south-east.

SWITZERLAND

Chemical outlook

There was an increase in the turnover of chemicals and pharmaceuticals during 1957. Exports during the first nine months of 1957, at 870 million Swiss francs, were approximately 20% and 26% higher than the corresponding periods of 1956 and 1955. Pharmaceutical products accounted for about 45% of the total value of exports; dyestuffs for 26% of the chemical exports. Towards the end of the year, however, orders decreased slightly and some reduction of production was expected. The demand for chemical products for the textile, leather, paper, soap and artificial fibre industries, which have been at a high level for some years, was reduced somewhat, a sign that saturation point was being reached.

GERMANY

Synthetic rubber plans

It has been reported that the Buna-Werke Huls GmbH. will start producing synthetic rubber at its new works at Marl (near Recklinghausen) this summer. The project will cost DM120 million and will initially have an annual capacity of 45,000 to 50,000 tons of 'cold rubber.' Later it is planned to extend the works so that it will eventually cover more than one-quarter of the annual German demand for raw rubber. At present, 50,000 to 60,000 tons of synthetic 'cold rubber' are imported from the U.S. each year at a cost of about DM2.40/kilo. It seems unlikely that the new German works will be able to compete with this price unless capacity is doubled within a short space of time.

NORWAY

Hydrogen fusion research

A group of scientists from the Norwegian Institute for Atomic Energy and the Astro-physical Institute are planning to establish a centre where practical research with controlled hydrogen fusion may be carried out. This includes the construction of an experimental reactor along the lines of the British *Zeta* machine. It is hoped that work can start this year. The research group is headed by Dr. Eberhard Jensen and Prof. Svein Rosseland.

ISRAEL

Liquid hydrogen

Liquid hydrogen has been produced and used in Israel for the first time with the aid of an installation which is the only one of its kind in the Middle East. Production of liquid helium was officially announced a few months ago. Both are being produced in the low-temperatures laboratory attached to the planning research department of the Ministry of Defence.

SOUTH AFRICA

Dolomite production

At Mooiplaats, near Pretoria, the South African Iron and Steel Industrial Corporation Ltd. (Iscor) has opened a new dolomite quarry with crushing and washing plant designed for a maximum output of 350 tons/hr. This development has been necessary to keep pace with the rising output of steel in South Africa. The Iscor organisation estimates that an average of 800 lb. of high-grade metallurgical dolomite is required per ingot ton of steel produced at Pretoria and Vanderbijl Park and, as it is planned to

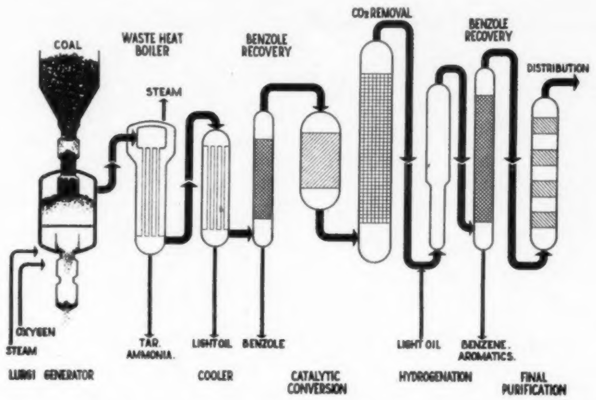


Diagram of the 'Lurgi' pressure gasification plant to be built by Humphreys & Glasgow Ltd. for the Scottish Gas Board at Westfield, Fife, Scotland. The project is commented on elsewhere in this issue.

increase the annual output of steel in South Africa to 2 million tons in the near future, it is essential to have an assured supply of dolomite.

Dolomite is being quarried at Mooiplaats for use not only as a fluxing agent in the production of steel, but as a basic refractory lining in the furnaces. Although the Corporation obtains the South-African-made basis refractories from outside sources, it is equipped with calcination plant in which burnt dolomite is produced to repair the furnace hearths and to cover the refractory bricks.

Water supplies and the law

Under the Water Act passed last year, any person who desires to establish an industrial undertaking which requires more than 50,000 gal./day of water must in future obtain a permit from the Minister of Water Affairs. Before such a permit can be granted some highly technical questions would have to be considered, and the Council for Scientific and Industrial Research expects that the Minister will call on the water research division of the National Chemical Research Laboratory for advice and assistance. The Bureau of Standards would be responsible for drawing up standard specifications for water purity. Logically, all specifications for effluent quality should take into account the circumstances under which the effluent is discharged and the uses which are made of the receiving body of water. This in turn calls for an extensive knowledge of the Union's water resources in relation to the uses to which they are put or may be put in future.

Such information can only be gained by extensive surveys of the various river systems. To date, surveys have been made of the Berg River in the Cape, the Vaal River Basin in the Transvaal, and the Tugela in Natal by the water research division of the National Chemical Research Laboratory. It is expected that a considerable expansion of this activity will have to be undertaken.

RHODESIA AND NYASALAND

Chrome

Southern Rhodesia is completing plans to increase its output of chrome, and it expects that by 1959 it will have achieved an annual export level of a million tons a year. This will mean an increase of nearly 250,000 tons on the 1957 estimated output, which will have a value approaching £5 million.

GREAT BRITAIN

Crop Protection and Pest Control Exhibition

The Crop Protection and Pest Control Exhibition, to be held at the Royal Horticultural Society's New Hall, Westminster, London, will be officially opened at 3 p.m. on Monday, May 12, by the Rt. Hon. Tom Williams, P.C., LL.D., M.P., who was Minister of Agriculture under the Labour Government for six years and enjoys the distinction of having had longer and more continuous service in this Ministry than any other member of the House of Commons.

Details of the Exhibition, which is sponsored by *World Crops*, were given in our March issue, page 78. Crop and pest control chemicals, apparatus and techniques will be included in the displays at this new exhibition, which already has promise of wide support from home and overseas.

AUSTRALIA

Industrial production

A survey of manufacturing activity, covering the period April to September 1957 and published by the Department of Trade, Melbourne, gives a good idea of current trends in the Commonwealth's main industries, including the following:

Alkalis. The alkali works at Osborne, South Australia, has continued to operate close to maximum capacity of 115,000 tons gross of soda ash p.a. Net output for the six months covered was about the same as for the previous period and has continued to meet demand. Total production of caustic soda approximated that for the preceding period. Overall productive capacity remains adequate for current and prospective requirements.

Chemical fertilisers. Superphosphate production has made a recovery, output for the six months to August 31, 1957, being 1,164,400 tons, an increase of some 20% compared with the corresponding period of the previous year. Ammonium sulphate production has continued at a high level, the tonnage produced showing a 25% increase over six months and 33% over the whole year. The increased output of ammonium sulphate is due principally to the Electrolytic Zinc Co.'s new plant at Risdon, Tasmania.

Plastics materials. With the important exception of polythene, nylon and acrylic resins, most of the main plastics materials are now being made in Australia. Overall output of phenol-formaldehyde resins and moulding powders during the period was a few per cent. higher than in the previous year. Overall output of amino-plastics remained constant, whereas output of cellulose acetate moulding powders was reported to be some 10% higher.

Pulp and paper. Production of pulp is up slightly and is now in the vicinity of 200,000 tons p.a. with the industry producing close to capacity. The present rate of newsprint production of nearly 80,000 tons/yr. is also close to capacity. Under existing conditions, it would be difficult to increase the present rate to any great extent.

Personal Paragraphs

★ **Dr. H. Kronberger,** O.B.E., is to be Director of Research and Development in the United Kingdom Atomic Energy Authority's Industrial Group. He succeeds **Mr. L. Rotherham,** whose appointment as a member of the Central Electricity Generating Board was recently announced.

★ **Mr. N. M. Peech** has been appointed a director of Albright & Wilson Ltd. Mr. Peech is chairman and managing director of the Steetley Co. Ltd. and has been a Treasury nominee on the board of Albright & Wilson's subsidiary company, Solway Chemicals Ltd., since 1952.

★ The death has been announced of **Mr. H. T. Eatwell,** managing director and joint deputy chairman of G. A. Harvey & Co. (London) Ltd. He was a member of the council of the Zinc Development Association, a former chairman of the Hot Dip Galvanizers Association, and a member of various committees of the Galvanized Tank Manufacturers' and other Associations.

★ **Dr. W. H. Garrett,** M.B.E., director of Monsanto Chemicals Ltd., has been elected president of the British Employers' Confederation in succession to **Sir Colin Anderson.** Dr. Garrett is vice-chairman of the Association of British Chemical Manufacturers and a life vice-president of the Association of Chemical and Allied Employers.

★ At a recent meeting, the Council of the Research Association of British Rubber Manufacturers considered the question of a successor to **Dr. J. R. Scott,** who is approaching retiring age, as director of research. Dr. Scott has been a member of the Association's staff for over 34 years and arrangements will be made to retain his services in an advisory capacity.

★ **Mr. H. P. Lord,** A.F.C., has been appointed general sales manager of Sigmund Pumps Ltd.

★ **Dr. Vannevar Bush** has been elected chairman of the board of directors of Merck & Co. Inc., New Jersey, parent organisation of Merck Sharp & Dohme International, manufacturing chemists. He was a central figure in nuclear fission development as well as in the mobilisation of the United States' scientific effort, including medical research during the war.

★ Following the completion of the acquisition of the Fletcher Miller Group by C. C. Wakefield & Co. Ltd., the following appointments to the boards of these two companies, and to that of Wakefield-Dick Industrial Oils Ltd., were announced: C. C. Wakefield & Co. Ltd., **Mr. S. R. Miller** (chairman, Fletcher Miller Ltd.); Wakefield-Dick Industrial Oils Ltd., **Mr. A. George** (director and secretary, Fletcher Miller Ltd.) and **Mr. R. T. Miller** (director, Fletcher Miller Ltd.); Fletcher Miller Ltd., **Mr. J. C. Cragg** (manager, Stanlow works, C. C. Wakefield & Co. Ltd.), **Mr. J. W. MacMahon** (general manager, industrial lubricants division, Wakefield-Dick Industrial Oils Ltd.) and **Mr. L. J. Windridge** (secretary, Wakefield-Dick Industrial Oils Ltd.).

RECENT PUBLICATIONS

Effluent treatment. A folder from Davey, Paxman & Co. Ltd., Colchester, shows at first a drab, effluent-laden river alongside a factory, but opens to reveal the same scene transformed into a charming stretch of blue water passing through green meadows. Rotary vacuum filters are the subject of this striking sales folder.

Nuclear equipment. Remote-handling equipment for atomic research work, electronic control gear, testing apparatus and special-purpose machinery are described in a new brochure available from the Ayling Nuclear Equipment Co., Horsham, Sussex. Apart from the English text, the brochure contains translations in French, German and Spanish.

Emulsions bulletin. Vinyl acetate monomer and polyvinyl acetate emulsions are manufactured in the U.K. by British Oxygen Chemicals Ltd. under the name *Vandike*, and a recently published bulletin describes the properties and main uses of these emulsions. Enquiries to: Vigo Lane, Chester-le-Street, Co. Durham.

Nitrile rubber preparation. The use of *Cellobond* rubber reinforcing resins in the preparation of nitrile rubber stocks for rubber sponge is described in technical note No. K203 obtainable from British Resin Products Ltd., Devonshire House, Piccadilly, London, W.1.

Dust control. Dallow Lambert & Co. Ltd., Thurmaston, Leicester, have issued an illustrated booklet (No. 55) describing the various types of equipment they produce to combat the dust menace.

Fluid control. A technical bulletin from Sunvic Controls Ltd. describes Model 63 constant-differential relay flow controller for use with small flows, while another describes the Model 18 diaphragm-type pressure transmitter, and Model 15 bellows-type pressure transmitter. Copies from: 10 Essex Street, London, W.C.2.

Pure water. A sales folder which explains their £45 water deioniser has been published by the Loughborough Glass Co. Ltd., Loughborough, Leics.

Lighting fittings. A range of flameproof fittings, specifically designed for use in oil refineries, petrochemical plants, gas works, coke-oven plants and other installations requiring flameproof, vapour-proof and dust-proof fittings are described in catalogue L600, available from Victor Products (Wallsend) Ltd., Wallsend-on-Tyne. In addition to standard certified flameproof fittings the company offers certified weatherproof/flameproof fittings.

MEETINGS

Institution of Chemical Engineers

April 16. 'Heat Exchange Equipment.' Joint meeting of North Western Branch with the Institute of Petroleum.

April 16. 'Synthetic Rubber Plants,' by A. E. W. Bailey, 6.30 p.m., Midland Institute, Paradise Street, Birmingham.

April 24. 'Modern Processes in Petroleum Refining.' Joint meeting of the North Western Branch with the Institute of Petroleum, Northern Branch, 7 p.m., College of Science and Technology, Manchester.

Institute of Petroleum

May 7. 'Advances in Petroleum Refining,' by W. J. Newby, 5.30 p.m., 26 Portland Place, London, W.1.

INTERNATIONAL CONFERENCES

April 13-18. American Chemical Society, San Francisco, California, U.S.A.

April 21-23. American Oil Chemists' Society, Memphis, Tenn., U.S.A.

April 27-*May* 1. Electrochemical Society meeting, New York, U.S.A.